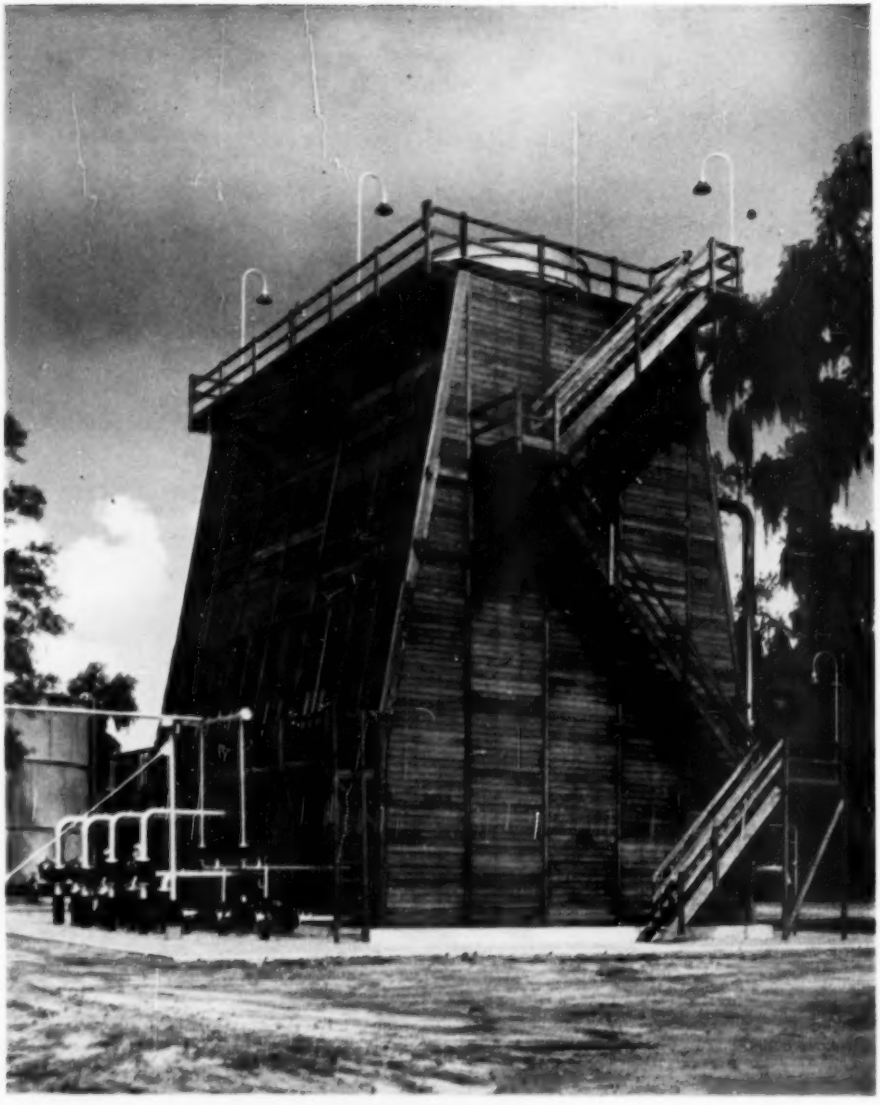
JANUARY, 1950
VOL. 5, NO. 1

PETROLEUM PROCESSING

Control Room Is Show Window For Modernized Refinery—p. 45



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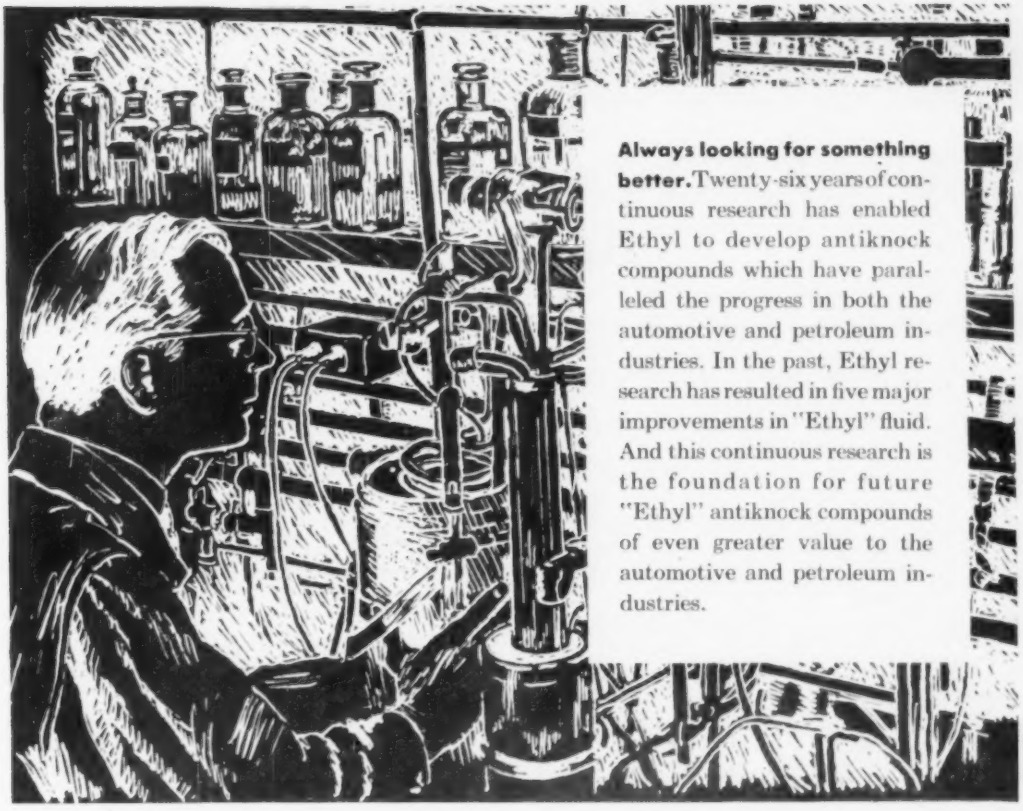

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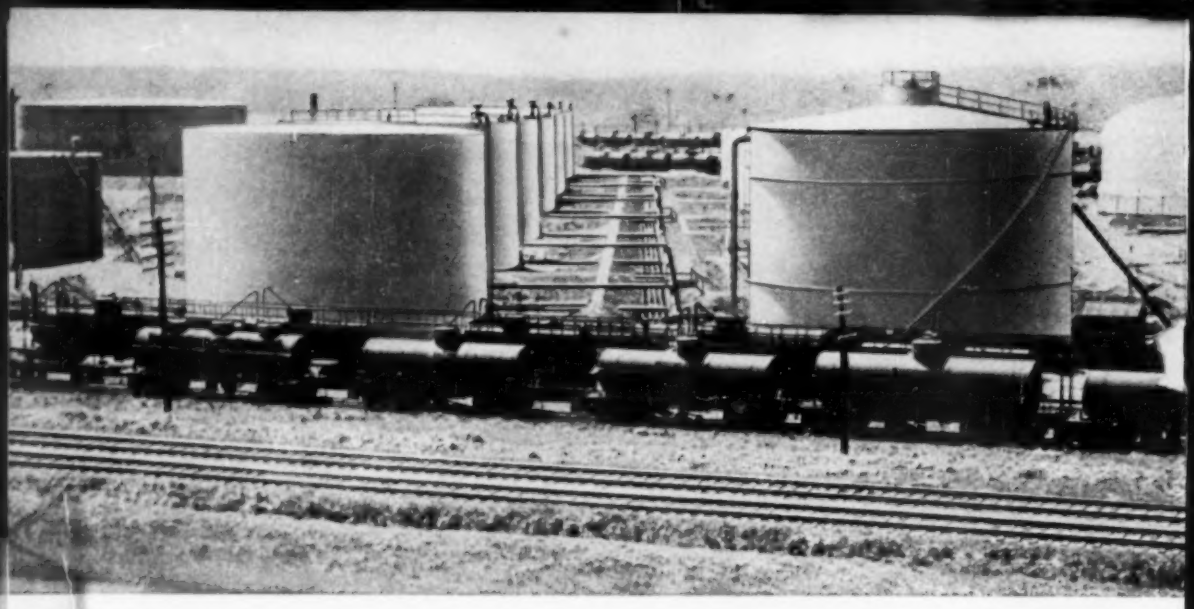

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- Breather Roofs
- Dry Seal Lifter Roofs
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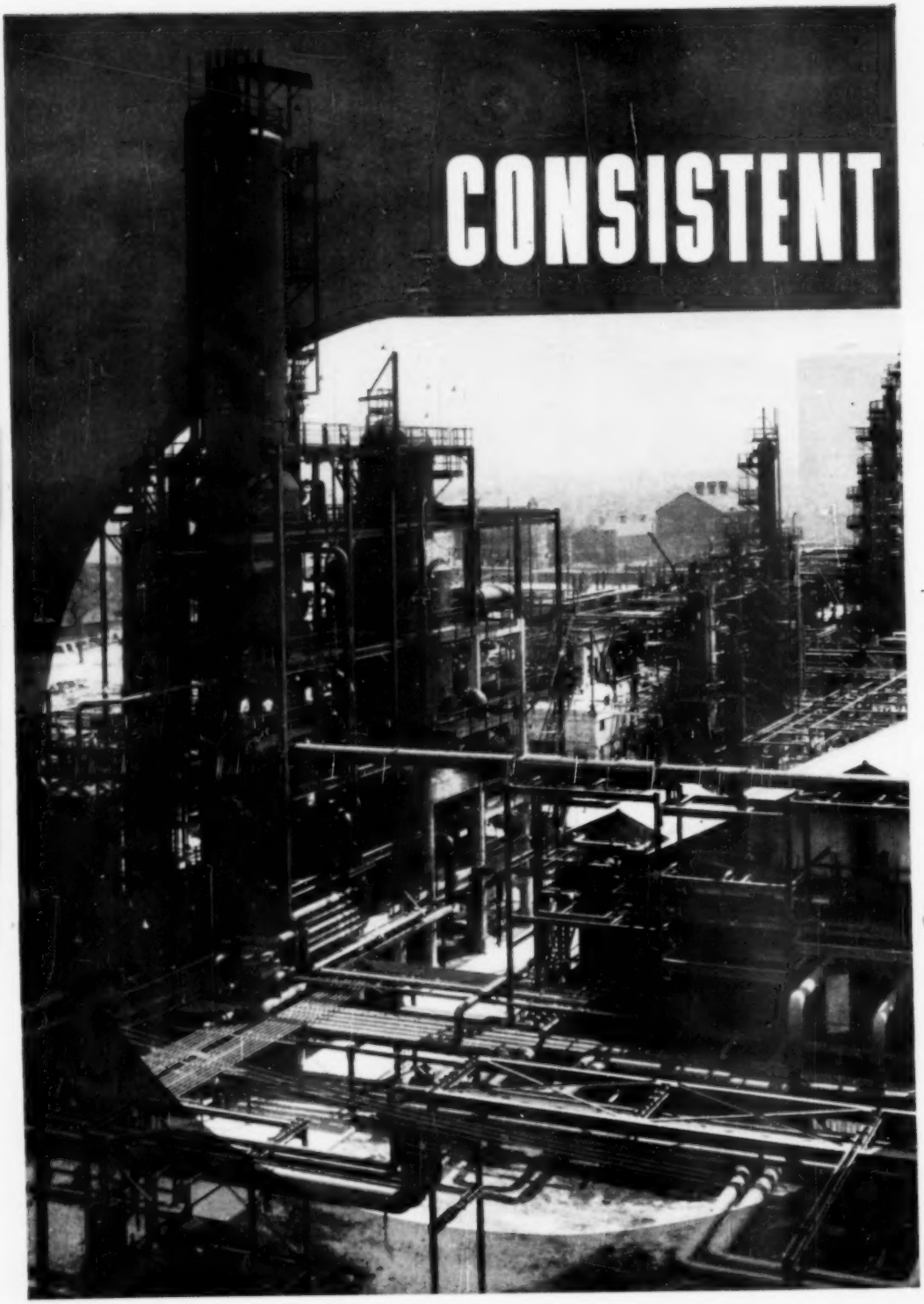
PLATT'S OILGRAM NEWS
A daily independent oil-news reporting service issued from New York, Cleveland, Houston

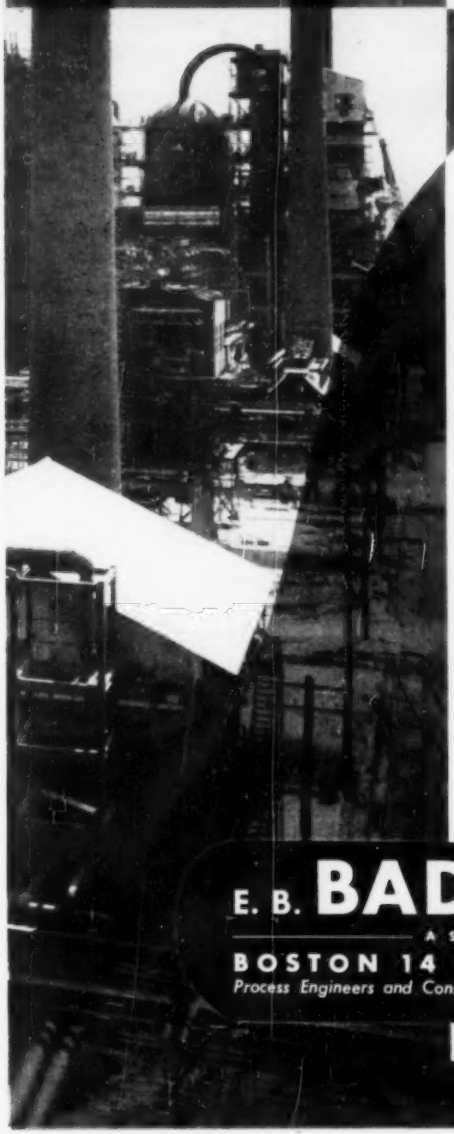
NATIONAL PETROLEUM NEWS
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

PLATT'S OILGRAM PRICES
A daily independent oil-price reporting service issued from New York, Cleveland, Houston


CONSISTENT

PROGRESS

in "The Heart of the Refinery"



This 32,000 barrel combination atmospheric-vacuum topping unit at Gulf Refining Company's Toledo, Ohio, refinery produces light and middle distillates as well as high quality catalytic cracking feed stock from sweet or sour crudes.

Wartime experience demonstrated the necessity for independent primary distillation facilities to maintain refinery balance when processing varying crudes. Hence this is the fourth two-stage unit which Badger has completed for Gulf's post-war program. All were engineered for wide flexibility in operation and with corrosion protection as determined by the economic balance between installation and maintenance costs.

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At right is the Chemico field office at Muscle Shoals where nitrate was produced during World War I. Above is the Construction Administration Area of the Jayhawk Ordnance Works, a Chemico World War II project.

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is the surest standard by which to test" WASHINGTON

CERTAINLY George Washington's yardstick of experience can be used to evaluate a business organization. It's the "surest standard", in fact, when you entrust responsibility for the design and construction of a heavy chemical plant.

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Chemico plants are profitable investments

What's Happening!

Important Current News Summarized for Refiners

EXPANSION

Standard Oil Co. (Ohio) has awarded engineering design and construction contract to Bechtel Corp. for converting its Houdry cracking unit at Cleveland to the Thermofor (moving bed) process. Feed preparation and gas recovery sections of existing installation will be used essentially as is, with Houdry catalytic section being scrapped and replaced with new TCC reactor-regenerator. Scheduled completion is Nov. 1, 1950.

Stancal Asphalt & Bitumuls Co. will build an asphalt plant at Point Wells, Wash., with construction to begin as soon as designs are completed and contracts let. Plant will have a modern vacuum distillation unit, office building, insulated storage tanks and complete shipping facilities. Crude will come from California by tanker.

Standard Oil Co. (Ohio) is almost doubling capacity of its lithographed can factory at Cleveland to handle its own needs as well as producing cans for other companies. Work will be completed by the end of 1950, cost $500,000 and enable Sohio to handle increased flow of products from its new solvent lube plant at Lima, now under construction.

Petroleum Specialities, Inc. is considering installation of a 3000 b/d catalytic cracking unit at its Flat Rock, Mich., plant. Erection of 30,000 bbls. of new tankage has just been completed there by Hammond Iron Works.

Shell Oil of Canada was reported in the October What's Happening (pg. 1063) to be installing a "modified UOP Fluid catalytic cracking" unit at its Montreal, Quebec, refinery. Shell has since called our attention to the fact that the unit was designed entirely by Shell Oil Co. engineers, and that the inference that the basic design was the UOP type unit is not the case. Shell explains that there "is a similarity between them in that both have two vessels supported by a common skirt," although UOP supports the reactor above the regenerator, and Shell supports the stripper above the reactor.

• • •

COMPLETIONS

Carthage Hydrocol expects to start preliminary runs in January at its Brownsville, Texas, gas synthesis plant, making gasoline from natural gas. Similarly nearly ready to go are Stanolind Oil & Gas Co.'s crude chemicals refinery and U. S. Industrial Chemicals Co.'s plant, which will separate and purify the synthetic chemical byproducts from the gas synthesis plant.

Skelly Oil Co.'s new Fluid cracking unit is undergoing test runs at El Dorado, Kans., and crude unit construction still is under way. Completion of the $10-million project will not be until April.

Freedom-Valvoline Oil Co.'s new filter plant at the Freedom, Pa., refinery has been completed, more than doubling capacity of the filtering facilities. Previously completed facilities include distillation and dewaxing capacity increase, new canning machinery, shipping facilities and storage.

• • •

MARKETS, PRICES

Winter trends finally were felt in December oil markets, but the squeeze on the refiner between crude and products prices continued as strong as ever. As heavy fuel prices tended upward, gasoline softened. Meanwhile, No. 2 fuel demand was not fully up to expectations because of warmer than normal weather throughout most of the nation.

Most refiners eyed distillate fuel oils as possible trouble spots pricewise if the weather doesn't turn substantially colder. There was a lot of No. 2 fuel to be sold between the end of 1949 and Mar. 1, 1950.

Crude prices continued shaky in most areas and made for cautious buying all along the line. Spot crude oil offerings found few eager buyers except at "off prices." Some of the crudes available were high gravity and sweet. There was one lot of 300,000 bbls. of "Ranger Type" 40 gravity Texas crude sold by Premier Oil & Refining Co. at "20c under the posted price." Current postings of most large buyers in that area are $2.65 for 40 gravity oil.

Ohio Oil Co. reduced its posted price for Byron and Garland, Wyo., crude oil 15c per bbl. to $1.50, and also cut back its posting for Oregon Basin, Wyo., crude 25c to $1.40 per bbl., effective Dec. 20. The company said "refinery yield from these heavy high sulfur crudes, except in the most modern cracking facilities, constitutes 60-65% heavy fuel oil."

Contrary to the trend, there was a boost in Penna. Grade crude prices touched off on Dec. 12 by a 14c per bbl. general advance in that district by the Joseph

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

Seep Purchasing Agency of South Penn Oil Co. The company's new price for Bradford-Allegany, National Transit and Tiona Sheffield crude was $3.54 per bbl.

Main developments in products were a sharp rise in heavy fuel demand in the Midwest and for kerosine at the Gulf. There were some increases in demand for distillates, but in most instances not enough to suit some refiners with substantial storage.

Advances in heavy fuel prices, generally about 10c per bbl., occurred in the Midwest, the Chicago district and some of the lake-ports. Prices for distillate fuels were up on the lows in the Midwest, in some instances in amounts ranging from 0.125 to 0.25c per gal. On the other hand, No. 2 fuel barge price at New York was off 0.2 to 8c per gal., and harbor traders said they foresaw no buoyancy in New York fuel oil prices until a real session of cold weather set in.

Gasoline prices softened in most areas. Gulf cargo prices were down an average of 0.375c during the month. Regular-grade, 83 octane Research was quoted at prices ranging upward from 9.375c; 90 octane Research premium from 10.375c.

Socony-Vacuum Oil Co. lowered its gasoline tank wagon prices in amounts ranging from 0.1 to 0.3c per gal. at 12 principal points in New York and New England, effective Dec. 16. Company said supply and demand were two main factors motivating its reductions.

Esso Standard Oil Co. reduced its cargo schedule for aviation gasoline at the Gulf on Dec. 27. Top grade 115/145 was cut 0.75c per gal. to 17.25c; other grades were cut 0.25c.

Other price highlights in December: Wax prices were relatively firm, particularly scale. One major said he was contemplating new year increase in his domestic and export quotations. LP-Gas prices were up generally 0.5c in the Southwest; New York and Philadelphia propane prices were up 0.25 to 6.25c. Solvent refined lubricating prices continued easy in the Southwest. In the Penna. refining district, the 14c crude rise had no immediate upward effect on prices for neutrals or bright stock.

• • •

SYNTHETICS

Joint coal-to-gasoline pilot plant operated for past 13 months by Standard Oil Development Co. and Pittsburgh Consolidation Coal Co. at Library, Pa., was closed Jan. 6. Plant had been testing fluidized solids technique for converting coal to gasoline.

In explaining the move, Standard pointed to "the return of a more nearly normal increase in oil demand" and "greatly increased world petroleum supplies," as indicating that "the need for converting coal to oil is not pressing, thus allowing time for further basic small-scale research."

Pittsburgh Consolidation, on the other hand, assailed the United Mine Workers at length for tactics which place "in jeopardy every new development using coal as the raw material." "No sane person," company president declared, "would dream of investing great sums of money in a venture which was tied to coal as a raw material when the future cost is so indefinite and the supply of coal so unreliable."

Engineers of both firms will continue to work over the mass of data collected during the pilot plant operations, and Pittsburgh Consolidation has indicated it may give considerable attention to natural gas synthesis.

Direct mining costs for oil-shale were cut to 29.2c per ton during the latest test conducted at its experimental mine near Rifle, Colo., according to the Bureau of Mines. Test period ran from Sept. 7 through Oct. 4, and cost figure is considerably below direct cost of 49.7c per ton during first run in Sept., 1948. Cost figures do not include depreciation and overhead.

• • •

TRANSITION

The Texas Co. is dismantling its San Antonio refinery and converting the site into marketing facilities. Usable equipment is being distributed to other company plants.

Atlas Processing Co. has been formed to operate the Atlas refinery and pipe line interests, effective Jan. 1, 1950. New owners are Chicago Corp., Carthage Corp., United Gas Pipe Line Co. and Triangle Refining Co.; reported purchase price was $1,300,000. Refinery has 12,000 b/d capacity.

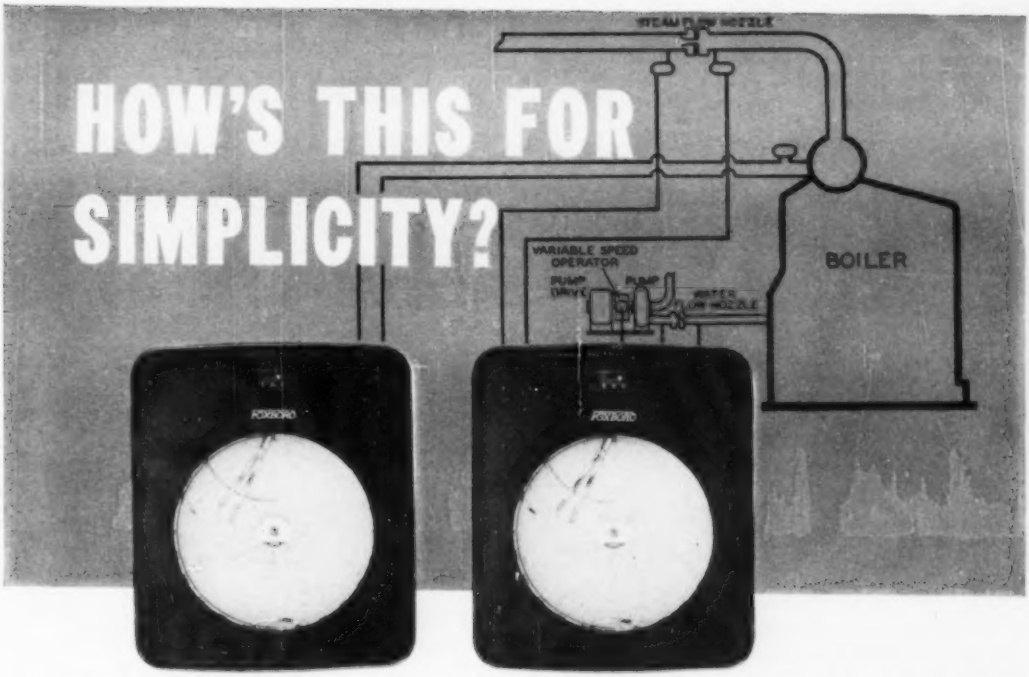
Freedom-Valvoline Oil Co. has been sold to Ashland Oil & Refining Co. Freedom-Valvoline has a 4,000 b/d plant at Freedom, Pa., which includes 1,000 b/d of thermal cracking capacity.

• • •

MISCELLANY

The Ranney horizontal drilling process, originally developed by Leo Ranney as an oil producing method, is back in the news. The newly-created Horizontal Underground Drilling, Inc., and Ground Water, Inc., recently announced they had obtained control of the process and were undertaking a world-wide scale of operations.

Independent Refiners Assn. of America has been organized by refiners in 25 states to act as a spokesman for the independents. Headquarters are in Houston and temporary chairman is Harry Leyendecker, vice president of Eastern States Petroleum Co.



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Engineering data are available to help you check and compare this system. Write **The Foxboro Company, 74 Neponset Avenue, Foxboro, Mass., U. S. A.**

THESE M-40 FEATURES INSURE UNUSUAL RELIABILITY

1. Unmatched ease and stability of adjustment **2.** Emergency-proofed—instrument can be dismounted without disturbing manual control panel **3.** Self-aligning ball linkage—pinch clip for easy removal **4** Main and sub-assemblies interchangeable with those of other M-40 Controllers **5.** Precision-built, inside and out **6.** Proportional band setting, 0 to 200, either direct or reverse action made by turn of dial **7.** Wide range variable reset resistance, 0.1 to 50 minutes, without use of needle valves or lengths of capillary tubing

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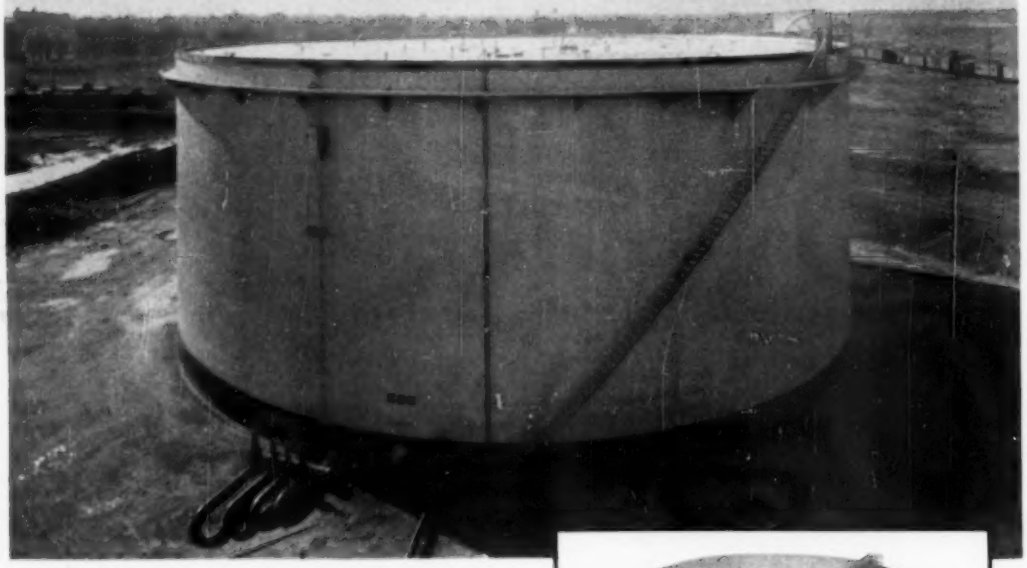

THE MORE *THEY* WORK— THE MORE *YOU* SAVE

Suppose you are using a cone-roof tank. "Filling" evaporation losses occur because the incoming liquid forces vapor out the vents. There are large "breathing" losses too. When the temperature rises, the air-vapor mixture in the tank expands and some of it escapes through the vents in the roof of the tank.

Now consider a tank equipped with a Horton Double-Deck Floating Roof. There is no vapor space between the liquid in the tank and the roof because this roof floats directly on the liquid surface. Eliminating the vapor space stops "filling" and "breathing" losses. Furthermore, the dead air space between the decks of the floating roof provides insulation which reduces evaporation losses due to vapor forming within the body of the liquid and rising to the surface.

WANT PROOF of how this saves? Examine the data at the right. In making these estimates, it was assumed that the tanks would be filled 6 times per year with *motor gasoline* valued at $3.78 per 42 U. S. gallon bbl. The annual cost of using a cone-roof tank is 17.41 cents per bbl. or *nearly double* the storage cost using a Horton Floating Roof.

For more details write the nearest office listed below.

Above: 96,000-bbl. tank with a Horton Double-Deck Floating Roof at Sinclair Refining Co., East Chicago, Ind. refinery.

Cutaway view showing construction of Horton Double-Deck Floating Roof in a butt-welded tank.

Annual Storage Cost Comparison

1) Tank with Horton Double-Deck Floating Roof
Initial Cost—$64,800 (80,000-bbl. tank)

Depreciation 10% of 64,800 =	$6,480
Standing Loss 180 bbls. x 3.78 =	680
Total ANNUAL Storage Cost =	$7,160

ANNUAL cost per bbl. = $\frac{7,160}{80,000}$ = 8.95 cents

(Note there are no filling losses!

2) Cone Roof Tank
Initial Cost—$47,800 (80,000-bbl. tank)

Depreciation—10% of $47,800 =	$4,780
Filling Losses—720 bbls. x 3.78 =	2,723
Breathing Losses—1700 bbls. x 3.78 =	6,427
Total ANNUAL Storage Cost =	$13,930

ANNUAL cost per bbl. = $\frac{13,930}{80,000}$ = 17.41 cents

* Trademark Registered in U. S. Patent Office.

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Birmingham 1	1527 North Fiftieth Street	Houston 2	2130 National Standard Building	Salt Lake City 1	1530 1st Security Bank Building
Boston 10	1029–201 Devonshire Street	Havana	402 Abreu Building	San Francisco 11	1208–22 Battery St. Building
Chicago 4	2114 McCormick Building	Los Angeles 14	1526 General Petroleum Building	Seattle 1	1330 Henry Building
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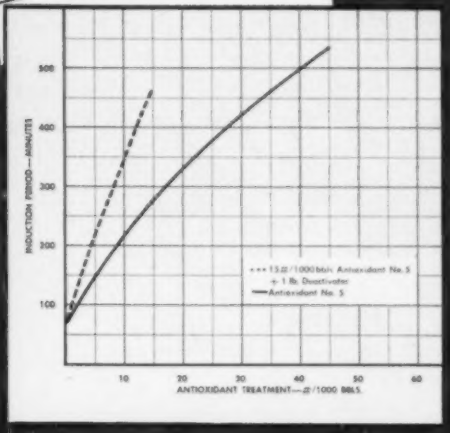
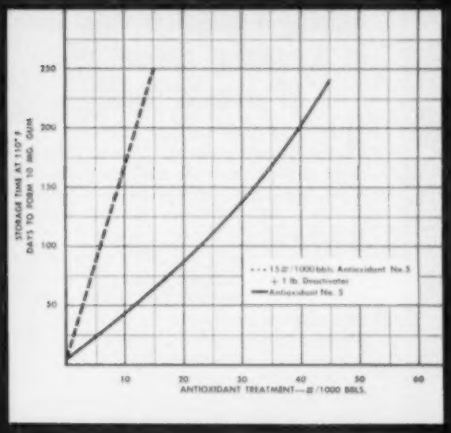
CASE HISTORY:



Results of induction period tests on stock containing 0.1 parts per million of copper, using Du Pont Antioxidant No. 5 alone, and combined with Du Pont Metal Deactivator.



Results of accelerated storage tests on the same stock using Antioxidant No. 5 alone and in combination with Du Pont Metal Deactivator.

Du Pont Metal Deactivator *Saves 48% in* Antioxidant Treating Costs

As little as 0.1 parts per million of copper is barely measurable by ordinary analytical methods . . . yet in some gasolines it may be enough to almost double antioxidant treating costs.

In this actual case history, to obtain a 460 minute induction period, thirty-five pounds of Du Pont Antioxidant No. 5 per thousand bbls. were required. This antioxidant was selected as the most effective of the three Du Pont Gasoline Antioxidants for use in this particular gasoline. The addition of one pound of Du Pont Metal Deactivator reduced the antioxidant requirements for the same induction period to fifteen pounds, a dollar saving of 48%.

Under actual, but accelerated, storage conditions, the pattern was the same.

Here is documented proof of the effectiveness of Du Pont Metal Deactivator in stocks containing traces of dissolved copper. In accelerated oxidation tests, response to Du Pont Metal Deactivator often shows the presence of copper that has not been detected by ordinary analytical methods. Du Pont District Laboratories will be glad to run a Metal Deactivator test on your stocks for you. Just call your Du Pont Petroleum Chemicals representative.

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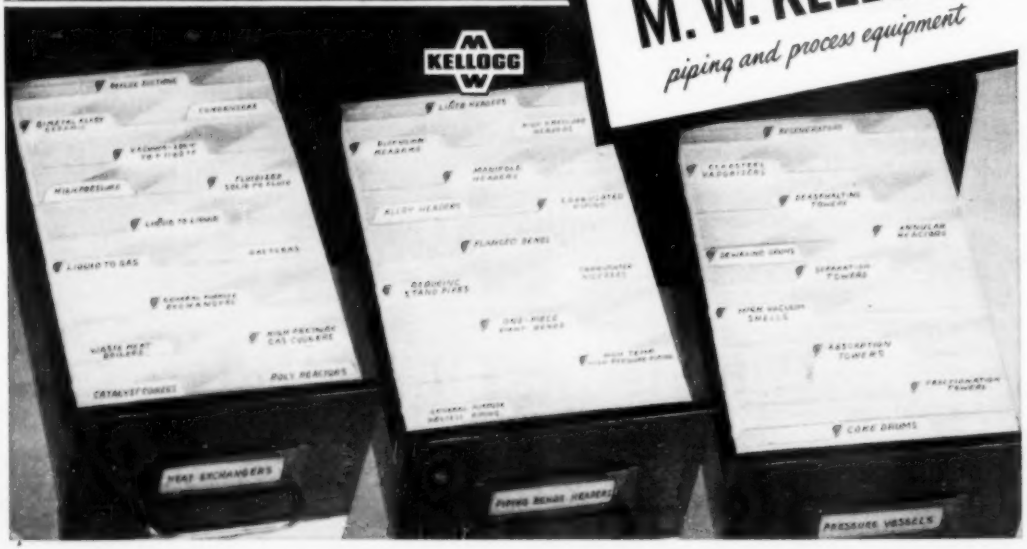

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Tomorrow
. . . IN PETROLEUM TECHNOLOGY

By B. H. WEIL, Atlanta, Ga.
Editor, "Monthly Summary of Industrial Developments"

Brief reviews of currently reported technological and economic developments, in the light of their potential bearing on petroleum refining

Solve Distillation Problems With Electronic Computer

IN these days of increasing complexity in the design of refineries, the use of mechanical methods of problem solution is taking hold rapidly. Mass spectrometers, while not "electronic brains" in the normal sense, are much in use in petroleum analytical laboratories. In a few research groups, "punched cards" and electronic sorting machines are being employed to correlate properties. Technical information groups have also been "much taken" by the possibilities of mechanical searching offered by punched cards and allied systems.

A few in the industry have also been well aware that elaborate "mechanical brains" such as a-c network calculators can be used to solve problems of fluid flow and heat transfer, and that other electronic computers can be employed to solve problems of a nonlinear nature. To many, however, some recent publicity concerning the use of Northwestern University's new computer for the solution of distillation problems may come as a distinct—though pleasant —surprise.

Few details were released concerning the actual operation of the Northwestern computer, but it was stated that "the new instrument uses electrical analogies for solving simultaneous plate-to-plate calculations" in solving problems in the design of "modern petroleum distillation columns"—problems whose solution normally involves tedious trial-and-error procedures. "Problems which formerly required from three to four days to solve may now be completed in a few hours. The computer is capable of making calculations for as many as six components. The calculation time per plate is about four minutes, compared with about 45 minutes per plate when hand calculated."

According to the news release, the Northwestern computer "differs from previously designed instruments in the type of mathematical problems it can solve." In the petroleum industry, "this computer will be of practical use (in problems concerned with) the separation of the light hydrocarbons and other components present in natural gas and refinery vapors. . . Of particular importance are the calculations required for variations of relative volatility and reflux ratio found in the design of refinery equipment."

Technical details of this computer will be awaited with interest. Refinery engineering offices may not be able to install such equipment in their own headquarters, but they may well be able to have access to this and related computers when needed for work on extended problems, much as power companies use a-c network calculators in the special laboratories of several universities.

Bacteria Still Laying Down Crude Deposits

OIL is being laid down in present ocean bottoms now, probably by the action of certain groups of bacteria on marine sediments similar to those from which our present supply is thought to have come, according to Dr. Claude E. ZoBell, professor of microbiology, Scripps Institution of Oceanography, La Jolla, Cal.(1)

He pointed out that most geologists agree oil is of animal or plant origin and, in that event, bacteria have contributed materially to the process. The pressures and temperatures which exist rule out most of the polymerization theories. However, strong evidence exists that bacteria occur at all depths where oil has been found, and that they are alive even with temperatures above 212° F. at high pressures.

TABLE 1 — Average Composition of Marine Deposits and Crude Oil

Material	COMPOSITION, % C	H	N	O	S
Marine Sapropels	52	6	11	30	0.4
Recent Marine Sediments (up to 100,000 years)	58	7	9	24	0.3
Ancient Sediments (older than 100,000 years)	73	9	3	14	0.2
Crude Oil	85	13	0.4	0.5	0.1

The older marine sediments tend to approach the average composition of known crude oils, as shown in Table 1 and this is believed in no small part due to anaerobic, sulfate reducing bacteria. These have been shown capable in the laboratory of decomposing fatty acids to liquid and solid hydrocarbons of paraffinic, naphthenic and aromatic types; some of these have highly branched chains. Investigations now are being made under various pressures (up to 600 atm.), chemical environments, Redox potentials and the like to see if altered environments may not increase the low hydrocarbon yields found in laboratory demonstrations.

According to Dr. ZoBell, alpha particles tend to release hydrogen from virtually all compounds containing it in the presence of water. Marine sediments are notoriously radioactive and thus satisfy all three requirements. In support of this belief it has been determined that petroliferous deposits are much more radioactive than adjacent rock.

Marine deposits contain sulfates and, with the presence of free hydrogen explained in the preceding paragraph, the step to production of H_2S by sulfate-reducing bacteria is simply explained. Moreover, bacteria are known and their presence demonstrated in oil, which are capable of deaminating, decarboxylating, deoxygenating and desulfurizing organic matter. Also, the bacterial cells themselves consist of 20 to 30% lipids; this material contains very appreciable amounts of hydrocarbons commonly found in crude oils.

Bacteria capable of producing methane, as in common marsh gas, have long been known and, 20 years ago, Linde hypothecated that methane in the presence of radioactivity could be transformed into ethane and higher molecular weight hydrocarbons with the evolution of hydrogen.

While it is not conclusively proven that in bacterial action upon marine sediments lies the answer to the mysterious origin of crude oil, Dr. ZoBell concluded, at least it answers many questions which other postulations have failed to clear up and continuing investigations are warranted.

What Raises LPG Prices— Fuel or Chemical Uses?

TWO recent pronouncements on the subject of the use of liquefied petroleum gases for fuel and for chemical synthesis are of interest because they differ sharply in their interpretation of the reasons for and potential effect of recent price increases for LPG.

In one of these,(2) Dr. R. C. Goodwin, manager of the special products department of the Shell Oil Co., has predicted that "supplies of propane are ample to meet forseeable demands for at least the next few years, but butane, because of in-

creasing uses in other fields, may be priced out of the LPG fuel market. . . . Butane is becoming increasingly scarce . . . because petroleum and chemical industries have developed products which demand larger and larger quantities of that liquefied gas. Its economic value to aviation-gasoline manufacturers already is considerably higher than it is to fuel distributors."

A different viewpoint—that *fuel* uses of the LPG's have increased their price to a point of concern to the chemical industry—has recently been voiced[3] by E. H. Riddle of the special products department of Rohm & Haas Co. Riddle states that "While there does not seem to be much doubt that sufficient natural gas and refinery gas will be available (for the production of synthetic aliphatic chemicals), the increasing price of these gases is a matter of considerable concern, *particularly since the chemical uses of these gases are not a sufficiently large proportion of their outlets to have an effect on the price of the hydrocarbons. Propane and butane have been increasing in price as a result of the accelerated use of liquefied petroleum gas (LPG) for heating purposes*, and it has been estimated that 21% of LPG sales were to the chemical industry in 1948.

"However, the volume of LPG used for fuel purposes may start decreasing because of increasing availability of natural gas by pipelines in many parts of the country. As a result of these increasing pipeline demands, it has been predicted that natural gas at the well head will sell for 15-20c per 1000 cu ft within the next few years, compared with 5-10c today. These shifts will naturally have their effect on the competition between processes that use methane on the one hand, and propane-butane on the other. They may also have their effect on chemicals such as the nitroparaffins, which have been held up from large-scale production partly because of the unfavorable propane situation.

"One effect of rising methane and propane-butane prices may be the increasing use of ethane as a raw material, and a thermal cracking process for converting ethane to ethylene has recently been announced. Other important developments in the ethylene field include the adaptation of the Thermofor cracking process to ethylene manufacture, and the design of a Hypersorber plant for recovery of ethylene from a refinery stream."

This difference in opinion may be explainaole on the basis of petroleum industry (Goodwin) versus chemical industry (Riddle) viewpoints, but it does not alter the implication that recent price increases for LPG may have periled future prospects, both for fuel use and chemical synthesis.

Bigger Demand for Jet Fuels Expected Within Five Years

TO quote a recent article[4] by Robert McLarren, "After a tumultuous chorus of 'So what?' thrown at the British jet airliners (D. H. Comet, Avro C-102), the U. S. aircraft industry has scampered back inside its plants and set busily to work on detailing, tool designing, and mock-up building on their jet airliners. Literally 'everybody's doin' it!' and the race to be first hasn't been matched by anything since 1945 when the industry turned to twin-engined postwar transport building."

"Two companies (Convair and Glenn L. Martin) are attempting to sneak in the back way by quick modifications to existing airplanes for turbo-prop power . . . but the remainder of the industry has its eyes solely on the pure jet liner."

Much has been said in print about the relative merits and demerits of jet transports as relates to the American scene. In addition to aesthetic considerations, such as lack of vibration and low noise, it has been pointed out by such authorities as Wellwood E. Beall of the Boeing Airplane Co. that "on flights of 1000 miles, the jet transport offers 'greater profit and speed potential' than the conventional airliner, even if it carries only a 50% load. High speed means more flights from each airplane. Fewer planes would be needed, and schedules would be faster. Seating capacity would be held down to 40 or 50 passengers. Obsolescence would hardly enter the picture. Once developed, Beall said, the jet transport in the 500-525-mph. class would be good for many years. The next step, a supersonic rocket transport, is a long way off, a matter of 'many decades.'"[5]

As regards problems involved, however, these are considerable:

1. Airline investments in current equipment are huge—many companies have investments of $3,000,000 to $6,000,000 in DC-6 and Constellation aircraft, and some are only now receiving $2,000,000 Boeing stratocruisers, and Convair Liners. For a proper return, such aircraft must be operated five to ten years.

2. Jet planes (the present type, at least) must land quickly after arriving at their destinations, since they can economically carry only small fuel reserves, but the navigational facilities at present airports necessitates "stacking up" of planes in bad weather, a problem which may not be solved for several years.

3. Present jet engines are said not to be sufficiently reliable for commercial service, to require much more frequent major overhauls, and to cost five or six times as much as piston engines.

4. The stopping of high-speed, heavily loaded aircraft on wet or icy runways has only recently been made safe by use of the reverse pitch propeller, and some new method will be needed for jet planes.

5. Upper-atmosphere flying may not be as smooth as anticipated—a British jet flyer recently reported terrific winds and heavy ice formation on wings.

Despite these arguments, Convair, Glenn L. Martin, Boeing, Lockheed, and Douglas, among others, are feverishly readying modifications of existing airplanes (for use of turbo-prop engines—considered by some as an intermediate step in the transition to jet engines) or designing entirely new planes—which may require as much as $22,000,000 for development.

"Witnessing this feverish activity with a slightly-amused but half serious eye are the U. S. scheduled airlines, whose 'We don't want 'em—the British can have them!' attitude 30 days ago (October) has quickly changed into a 'Well, let's see what you've got!' reaction. There now appears one certainty: U. S. airlines will *not* buy any British jet airliners, or any other kind of airliners, for that matter. If any are purchased they will be the homegrown variety, and this positive 'Buy American' policy has hastened even conservative aircraft manufacturers to take the plunge.

"No one, at this point, is even guessing where the money is coming from, but this no longer comprises a serious barrier to jet transport progress. Congressional adjournment without action on the 'Prototype Bill' cast the final die in favor of going ahead with company reserves, sinking funds, borrowings—whatever cash or credit can be obtained. The airline attitude follows the same optimistic course, aided and abetted, however, by a general loosening of credit in the face of rising profits."[4]

The airlines are said to feel that jet planes can be justified by introducing them initially at premium service rates, whereby "the traveling public can (and will readily) pay the bill."[4]

All of this means that—two to five years from now, or thereabouts—the petroleum industry may expect demands for increasing supplies of jet fuels. This factor must definitely be weighed in considering future balancing of refinery product yields.

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(1) Claude E. ZoBell. "The Possible Role Played by Bacteria in Petroleum Formation." Paper presented before Tulsa Section, American Institute of Chemical Engineers, Nov. 5, 1949.

(2) Anon., *Oil and Gas Journal*, 48, No. 28, 116 (1949).

(3) E. H. Riddle. "Aliphatic Chemicals." *Chemical Industries*, 65, No. 4, 505 (1949).

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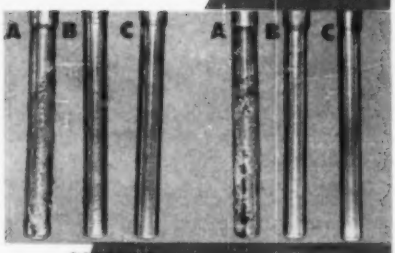

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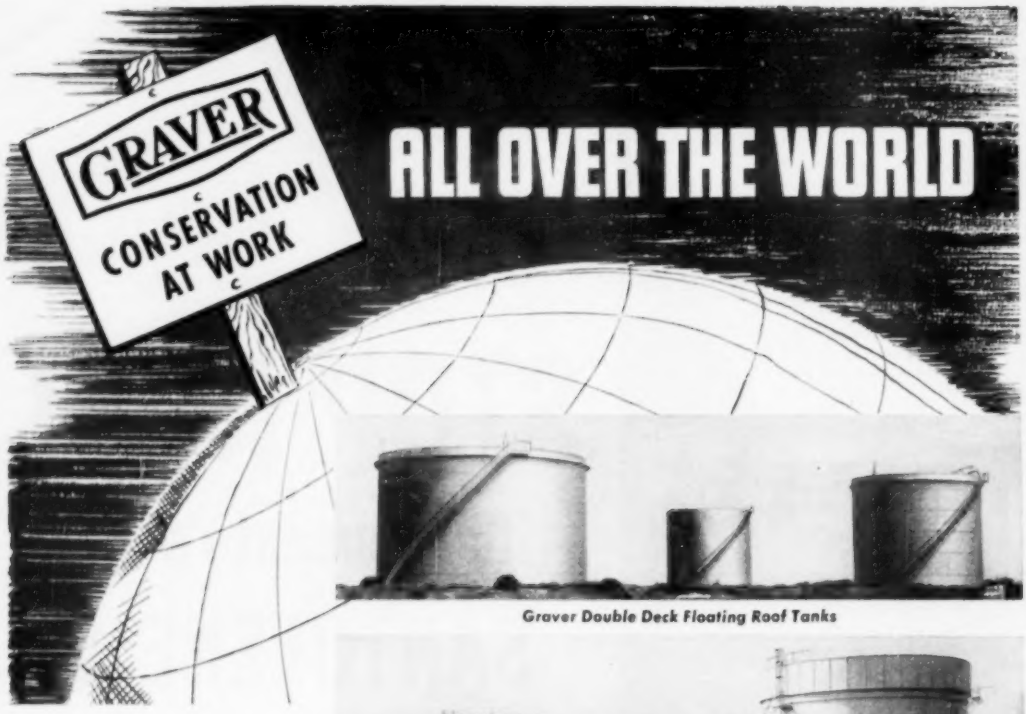

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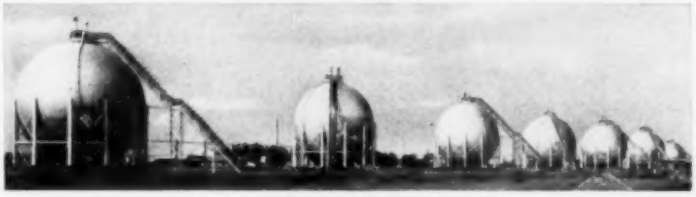

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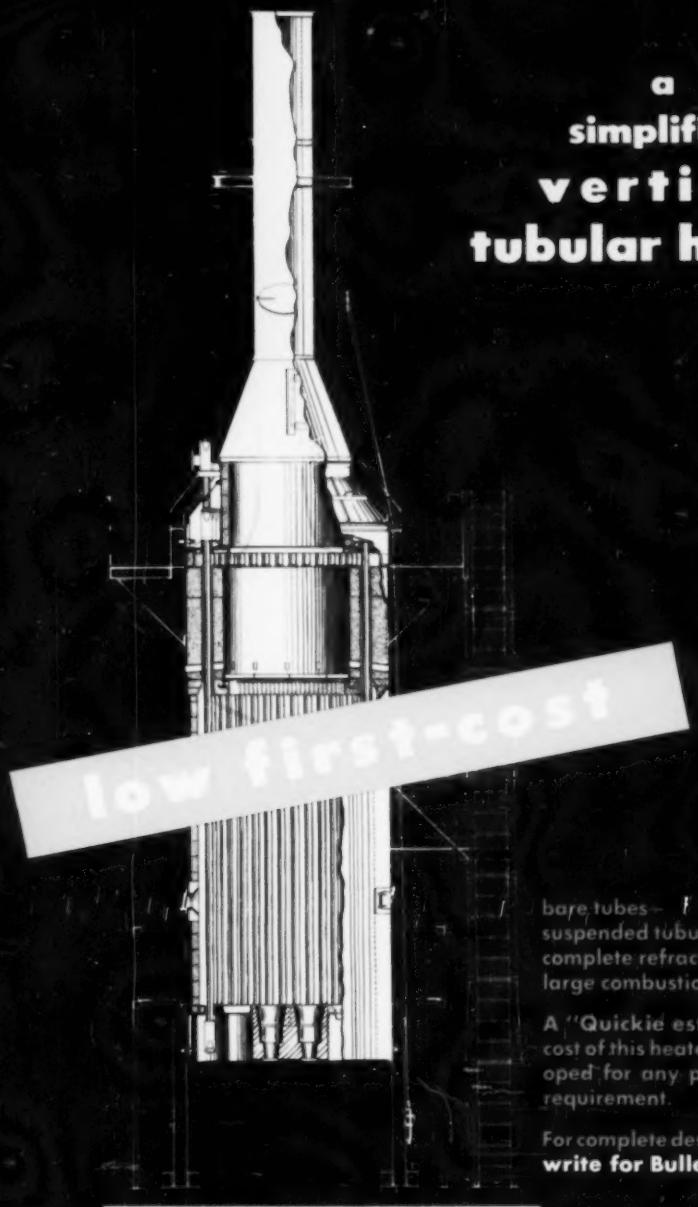

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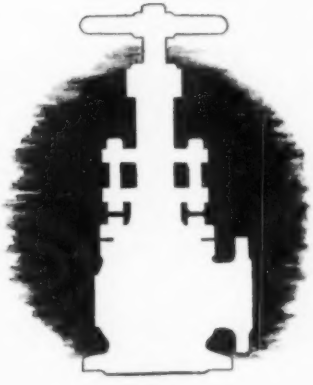

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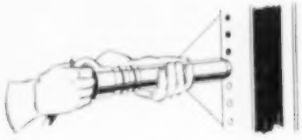

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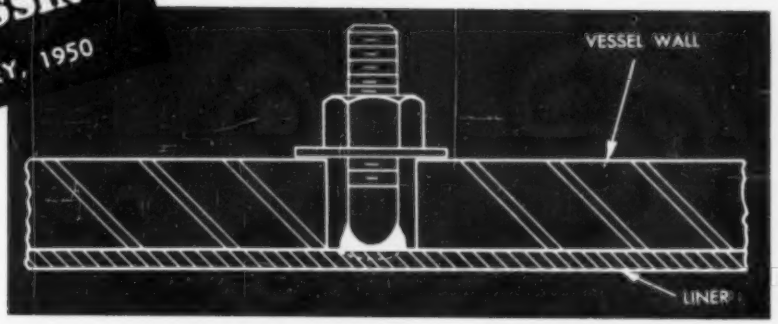


Fig. 1—Method for attaching alloy liner to vessel wall by stud welding

New Techniques for Lining Vessels For Protection Against Corrosion

From a Report by G. C. CARPENTER, Manufacturing Dept.
Esso Standard Oil Co., Louisiana Division

A series of experiments with methods for applying corrosion-resistant liners to refinery vessels resulted in the development of a new technique, stud-welding, which is to be further tested in the field. As a result of the experiments, plug welding was discontinued in practice and various types of strip welding are now used, depending on temperature and other conditions. The selection of liner materials may be a complex problem, it has been learned, in which conditions of the specific application are the most important factor.

The report which is reviewed was presented by the author at the meeting of the American Society of Mechanical Engineers, Oklahoma City, Oct. 2-5, 1949, under the title "Corrosion Resistant Liners in Refinery Vessels and Equipment."

NEW methods for attaching alloy strip liners to vessel walls have been developed at the Baton Rouge refinery of Esso Standard Oil Co., Louisiana Division, as the result of an extensive series of tests started in 1945.

One technique studied calls for welding the lining strip to a threaded stud in an insulated ferrule pushed through a hole drilled in the vessel wall. This method is under further study, for it is believed to offer a possible means for attaching a wider range of liner and vessel materials than can be done under existing methods. On this technique it is stated:

"One of the most recent methods of attaching liners to vessels which has been investigated involved the use of stud welding. Here the liner was backed up against the interior shell wall and a threaded stud in an insulated ferrule was pushed through a hole drilled in the vessel wall and welded on contact to the outer surface of the liner. This operation was facilitated by the use of a patented "gun", which held the stud and applied the current at the proper time. After the stud was welded to the liner, a nut and washer combination was used to draw the liner into firm support. (See Fig. 1)

"Attachment of liners to drums and large pipe by stud welding would seem to have certain advantages over other methods presently used. The material of which the vessel is constructed does not limit the selection of a liner material. It has been suggested that a wooden barrel might easily be lined with brass by this method should it ever become desirable to do so.

"While this is cited as an extreme case, other unusual contrasts in liner-vessel material may be more practical. Liners for cast iron vessels, which are exceedingly difficult to attach by conventional methods, offer no special problem when attached by stud welding. The initial studies of lining material attached by stud welding also indicate that this method presents the advantages of plug welding without the disadvantages, and it is planned to follow up this experimental work with field tests at an early date."

The principal purpose of the tests at the Baton Rouge refinery on methods of attaching alloy liners to vessel walls was to compare the plug welding technique in use at that time with strip welding. Results of the tests led to the conclusion that plug welded alloy liners should be discontinued.

Lapped, fillet welded strip liners should be used, it was decided, for

all non-ferrous alloy lining and for any ferrous alloy lining where it is subjected to corrosion by aqueous solutions where there may be fear of the exposed welds being more subject to corrosion because of contamination by the carbon steel or base plate metal.

Consideration should be given, it was concluded, to the use of butt welded strip liners where ferrous alloys are used in high temperature service (above 600° F.), or where it is necessary that a smooth internal lined surface be obtained.

Concerning the size of the strips, it was concluded that essentially the same consideration for the width of the strip should be given as was formerly done in handling the spacing of plug welds in plug welded liners. Narrow strips, 3-4 ins. in width, should be used for high temperature service; whereas wider strips, 6-8 ins. or even wider, could be used for low temperature service. The length of the strips was immaterial, it was decided, except from the standpoint of ease of handling and of installation.

Since the tests of methods of attaching alloy liners were made, a number of installations have been made using the strip welded method. Where the liner has been Monel or other non-ferrous metal, the lapped strip method has been used to prevent carbon pickup in the exposed weld. When using 18-8 chrome nickel liner material, the strips have been butt welded together, simultaneous with welding to the vessel wall. The difference between non-ferrous and ferrous metals seems to lie in the fact that, since the non-ferrous have no iron to start with, any pickup is 100% contamination.

On the other hand, ferrous alloys contain a large percentage of iron initially, and it is felt that the addition of a small amount through pickup from the carbon steel shell would have little or no detrimental effect on the corrosion resistance. In addition, a higher alloy rod is normally used for welding ferrous strips, so it would be expected that the resulting weld would have corrosion resisting properties exceeding those of the liner material.

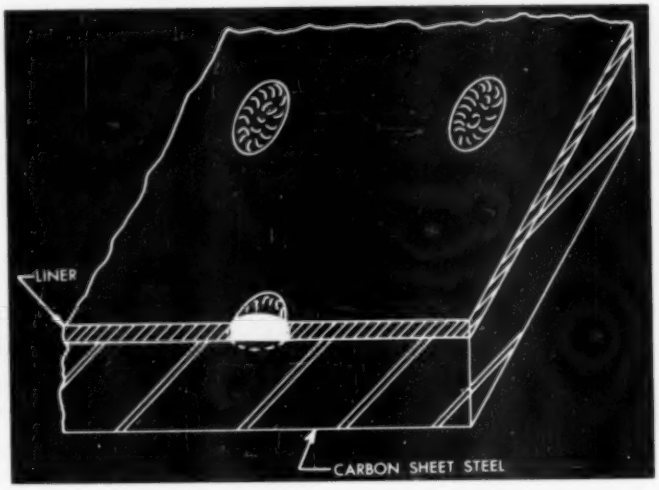


Fig. 2—Technique for attaching liners by plug welding

The 1945 series of tests on methods of liner attachment at Baton Rouge were started largely because the results from plug welding had not been satisfactory. The early corrosion resistant alloy liners were, without exception, plug welded. Small holes were punched on predetermined centers in the lining material, which was taken into the vessel to be lined in as large sheets as the manhole openings would allow. The liner sheets were backed up against the vessel shell, tacked into place and subsequently welded to the shell at each hole with a suitable rod. Edges of the liner sheets were welded together and to the vessel shell.

Soapy water was then spread over the lining surface and air pressure applied to the space between the shell and the lining. Pinholes and cracks could then be detected by the soap bubbles that formed on the interior surface. The large number of small welds with plug welding provided numerous places for pinholes to occur. Leaks would break through in service, even after the liner had been made completely tight on installation. The plug welds were virtually impossible to repair once they had been in service and leakage occurred. These leaks did not result in further corrosion behind the liner, but did permit the progression of fouling and coking between the liner and vessel wall to the extent that the liner would tear away from the attachment welds.

Five methods of attaching the alloys to carbon steel base plates were used in the tests undertaken at Baton Rouge: (1) plug welded, (2) strips welded to base plate and then butt welded together, (3) strips lapped and fillet welded with the unexposed edge continuously welded to the base plate, (4) strips lapped and fillet welded with the unexposed edge intermittently welded to the base plate, and (5) one-half the total number of strips used to be entirely fillet welded to the base plate, the spacing of these strips to be such that one strip would completely cover the space left and would also lap over the strips on either side enough for a fillet weld to be made which would not be contaminated by the carbon steel base plate. Table 1 indicates the alloys used in the tests.

The plug welded linings were prepared by welding the alloy material to the base plates through 15/16-in. diam. holes punched on 4-in. triangular centers, as shown on Fig. 2. The alloy plates were 3/32 in. thick, 24 ins. wide and 30 ins. long. The

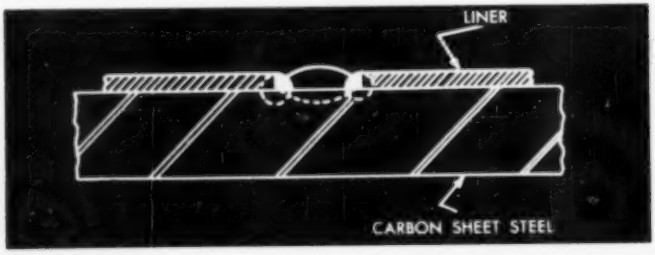


Fig. 3—Detail of attaching liner strip by butt welding

carbon steel base plates were ½-in. thick, 30 ins. wide and 36 ins. long.

The butt welded strip linings were prepared by first fillet welding the alloy strips to the base plate and then butt welding adjacent strips together. (Fig. 3). The individual strips were so spaced that their adjacent parallel edges were approximately ⅜-in. apart, thus allowing fillet welds to be made so that one did not overlap the other. The finishing butt weld between strips was then applied as a filler bead in such a manner as to overlap both adjacent fillet welds. The alloy strips were 3/32 in. thick, 4 ins. wide and 30 ins. long and the carbon steel base plates were similar to those used in making the plug welded samples.

The lapped and fillet welded strip lining test plates were prepared by overlapping the adjacent edges of the strips approximately ½ in. to ¾ in., with the unexposed edge fillet welded to the carbon steel base plate, and the exposed edge fillet welded to the adjacent alloy strip, as shown in Figs. 4 and 5. In one set of two test plates, the fillet weld along the unexposed edge of the strip was intermittently welded, and in the other set of two test plates the fillet along the unexposed edge of the strip was continuous. The sample plates prepared with the intermittent weld were 3/32 in. thick, 4 ins. wide and 30 ins. long, whereas the plate prepared with the continuous weld was 3/32 in. thick, 6 ins. wide and 30 ins. long. The carbon steel base plates making these samples were the same as in the previous cases.

TABLE 1—Alloys Used in Tests at Baton Rouge Refinery on Methods for Attaching Liners to Vessel Walls

Sample	Lowest Pressure at Which Pinhole Leaks Occurred	No. of Pinhole Leaks at Lowest Pressure	Total No. Leaks Exclusive of Leaks at Rupture	Rupture Gage Pressure psig
1. 18-8 Chrome Nickel Plug Welded	200	6	7	400
2. 18-8 Chrome Nickel Plug Welded	300	7	7	450
3. 18-8 Chrome Nickel Strip Butt Welded	150	2	6	600
4. 11½ to 13 Chrome Plug Welded	200	1	1	350
5. 11½ to 13 Chrome Strip Butt Welded	200	2	5	800
6. 11½ to 13 Chrome Lapped and Fillet Welded*	200	1	1	330
7. Monel Plug Welded	200	4	4	375
8. Monel Strip Butt Welded	100	3	8	825
9. Monel Lapped and Fillet Welded*	100	1	1	225
10. 18-8 Chrome Nickel Lapped and Fillet Welded**	270	1	1	320
11. Monel Lapped and Fillet Welded**	----	0	0	220

* Unexposed edge intermittently welded.
** Unexposed edge continuously welded.

The hydrostatic test of the sample lining installations showed that the quality of the finished and exposed welded joints was probably the most important single factor involved in any of the methods used. From Table 1 it can be seen that a total of 41 pinhole leaks in the welded joints were found during the various tests, and these leaks were exclusive of those which occurred at the time of complete failure of these test plates. From these tabular data, it was noted that pinhole leaks were quite prevalent in both the plug welded and butt welded strip liners. Of the 41 leaks, 38 occurred in either one or the other of these two methods of installation. Of the 4 sample plates which were prepared by lapping and fillet welding the strips, one plate showed no pinhole leaks and the other 3 plates showed only one pinhole leak for each plate.

An additional purpose in applying hydrostatic tests to the sample liner installations was to simulate stressed conditions which exist during actual operation of lined vessels, where variations in temperature between vessel and liner, together with dissimilar thermal expansion coefficients, frequently cause high stresses at points

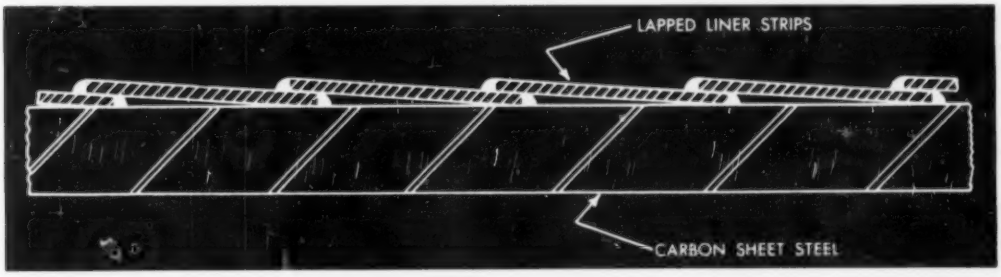


Fig. 4—Attaching alloy liner by lapping and fillet welding the strips

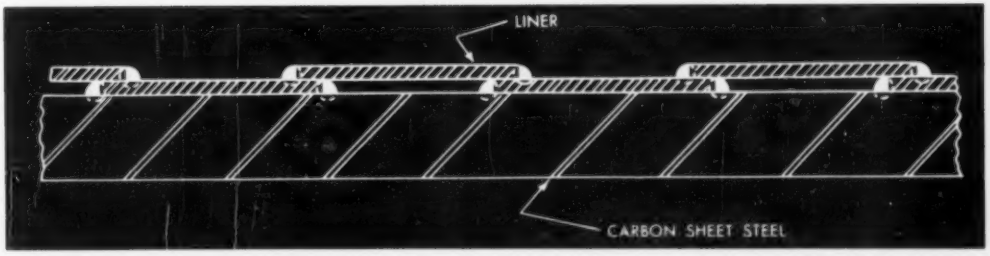


Fig. 5—Complete overlapping, in which fillet weld is not contaminated by carbon steel shell

of attachment. From the test pressures shown in Table 1 which were required to cause the alloy liners to fail, it is readily noted that the strip welded liner with the strips butt welded together offers the greatest resistance to complete failure from pressure between the alloy and carbon steel plates; also that the lapped and fillet welded strip liners offer the least resistance to stresses set up by the hydrostatic force.

From the results of the tests, the different methods of installing alloy liners studied may be compared as shown in Table 2.

Selection of Lining Materials For Vessels and Equipment

SPECIFIC materials for lining refinery vessels and equipment at the Baton Rouge refinery are selected with great care. Corrosion can be retarded by selecting materials which will not corrode at an accelerated rate. The problem of selecting these materials may be complex and frequently each corrosion problem must be treated separately, since there may be little relation between conditions which appear to be quite similar.

The use of corrosion test spools of the International Nickel Co. type probably offers the most reliable method for determining the relative corrosion resistance of materials to corrosive atmospheres and liquids. Detailed recommended practices for such tests are outlined in ASTM Spec. A224-46. It is important that the test spool be located so it is properly exposed to conditions responsible for corrosion. Factors which must be considered include phases in mixtures of insoluble liquids, velocity effects, turbulence effects, and impingement.

From studies made of liner materials other than alloys the conclusions to date indicate that glass lined equipment presents an unsatisfactory maintenance problem unless special handling techniques are employed.

Plastic coatings offer much promise as corrosion resistant liners in atmospheric temperature service. The importance of proper surface preparation cannot be too greatly emphasized and every effort should be made to follow the manufacturers' recommendations for application of the coatings. These conditions are more easily met under shop conditions than in the field.

Following is a resume of experience of the Baton Rouge refinery with alloy and other liner materials:

Alloy Liner Materials

18-8 Chrome Nickel Steel: Has been used as liner material primarily to combat sulfide corrosion in medium and high temperature service, 550°F. and above. Older liners are mostly AISI Type 302, those currently installed Type 304. In some cases of plug welded liners, cracking has occurred around the weld, believed due to lack of ductility in that area, aggravated by stresses developed due to differential expansion encountered in high temperature service. The necessary conditions leading to intergranular corrosion of 18-8 chrome nickel steel do not exist in locations where this material is used in lining service, therefore it is felt that the advantages of Types 304 and 347 over Type 302 are partly academic.

Monel: This natural alloy containing 68% nickel and 29% copper has been used extensively in overhead equipment and other locations where lower temperatures prevail under conditions which promote chloride and sulfide corrosion. Every precaution is taken to prevent iron pickup in exposed welds made during installation of monel liners. Such liners are installed exclusively by the lapped, strip welded method, (No. 3 in Table 2), in those cases where clad material cannot be used.

Hastelloy B: In a particular instance, carbon steel pump casings had given good service over an extended period while pumping 98% sulfuric acid. However, when the throughput of the pumps was increased, the acid came through the casings in a matter of days. Apparently the normal protective coating on the carbon steel was being washed off, leaving fresh metal continuously exposed to acid attack.

Hastelloy B, a nickel-moly-iron alloy, provided the best solution to this problem. It has sufficient resistance to attack by both hydrochloric and sulfuric acid, as well as the additional necessary quality of toughness. It has been widely used at Baton Rouge to line acid pumps. Method of attachment is welded-in, the liner material being deposited from a Hastelloy B rod.

Inconel: To protect against possible stress corrosion cracking (or caustic embrittlement) of steel equipment into which caustic is injected, Inconel, a nickel-chrome-iron alloy, has been selected as the most desirable lining material. It is not normally susceptible to stress corrosion cracking, and tests indicate excellent resistance to sulfide corrosion. Lining is usually accomplished utilizing lapped and fillet welded strips (Method 5 in Table 2) so that the exposed welds are pure Inconel.

Other Liner Materials

Lead: Used extensively in sulfuric acid service where concentrations up to 98% may be expected. Support of the liner is considered the primary problem. Lead lining of steel plate may be accomplished either by hand bonding narrow strips of lead to the steel, or by the mechanical installation of lead in large sheet form. The latter method is favored because of the economics of installation and corrosion resistance. Some method of installation involving the use of lead covered bolts and structural members is generally used at Baton Rouge. In such vessels as acid reboilers, an inner lining of acid resistant brick helps support the lead lining at elevated temperatures.

Critical temperature for lead liners is considered to be 250°F., the lead tending to reach a plastic stage at this temperature. Where vibration is a factor, experience has shown that tellurium lead can be work hardened and still retain its high corrosion resistance.

Brass: Brass lined vessels are not used at present in Baton Rouge. Some brass lined pipe is used where sulfide corrosion at low tempeatures is known to occur on carbon steel; also, numerous brass lined cocks and valves are employed. Some cast iron valves have welded-in brass trim, applied by brazing. Experiments have been conducted to determine the feasibility of strip lining carbon steel vessels with brass. The strips were lapped and fillet welded, using carbon arc and "Everdur" rods. Preliminary evaluation of the tests indicates such liners offer much promise in field service where temperatures below 350°F. prevail.

Glass: This material has never been used extensively as a liner material at Baton Rouge, although its superior properties for corrosion resistance are recognized. Glass linings have been used in large equipment where a smooth interior surface is necessary to prevent coking or build-up of solids that might adhere to a normal metal surface. A considerable quantity of glass lined pipe was used when chemical products operations were begun. It was found, however, that it was particularly susceptible to damage when handled by mechanics not accustomed to its fragility. Where damage occurred, field repairs were virtually impossible. Such equipment has since been replaced by carbon steel piping lined with lead and carbon, together with much brass and copper piping.

Cements: Have been used to line vessels and equipment against corrosion and erosion. Hexteel or sim-

ilar expanded metal is used to support cements. Gunite liners have been installed in naphtha treating drums, hydrogenation coolers and crude storage tanks. It is necessary to use extreme care when guniting vertical walls to prevent subsequent cracking. Tank bottoms present a more practical application for cement linings.

In locations where excessive metal loss has been encountered from erosion, cements with hexteel have proven effective during normal runs and relatively easy to renew during turnarounds. Fluid catalytic cracking operations offer much opportunity for use of this type of liner.

Plastics: Use of plastic paints appears to exhibit some promise of combatting corrosion. In lower or atmospheric temperature service, they seem to offer excellent corrosion resistant properties, but thus far their use has been limited due to deficiencies in their application to metal surfaces. Metal surfaces must be scrupulously clean to even approach a suitable bond, and the manufacturer's recommendation for application must then be carefully followed for each of the several coats, with adequate drying time for each.

There is a distinct disadvantage to following such a practice in painting refinery equipment during normal turnarounds due to lack of sufficient time. Also, in the field the chances are that some areas will not be cleaned thoroughly enough prior to painting, and the coating will subsequently fail through lost adhesion in such areas even though it is resistant to corrosive attack. On the other hand, excellent service has been experienced where plastic paints have been applied in a shop under carefully controlled conditions.

Hot baked phenolic resin paints have been used to line acid pump casings and valves in acid service. Limited service as yet does not allow an accurate evaluation of these liners, but preliminary economic studies appear favorable to this type of liner in some acid services.

Vinyl type paints have been used as protection against river water corrosion, acid leaks or spillage, and salt and caustic corrosion. Some vinyl coatings have been external and others internal. Investigation of plastic coatings in field service forms an important part of the refinery-wide paint program at Baton Rouge. Manufacturers are constantly improving their product, while company and contract painters are recognizing that plastic paints require special technique during application. This combination may well lead to more general use of this type coating in corrosion resistant service in refineries.

TABLE 2—Comparison of Methods of Installing Alloy Liners in Refinery Vessels

METHOD 1—Lining installed by plug welding.

Advantages

A. No apparent distinctive advantage over strip lining.

Disadvantages

A. From every consideration, such as quality of finished weld, ease of installation of lining plate, cost of punching holes for plug welds, etc., this method appeared to be inferior to other methods tested.

METHOD 2—Lining installed by use of strips fillet-welded to base plate and then butt-welded together.

Advantages

A. Offers greatest resistance to any pressure force tending to pull it loose from base plate.
B. Provides a smooth finished surface desirable for lining equipment such as exchanger shells.
C. Narrow lining strips, which do not have to be punched with holes, can be easily taken into vessel through normal size manholes.

Disadvantages

A. All welding exposed to action of any corrosive agent is more or less contaminated with the carbon steel or base plate material.
B. The contamination (A) makes it impossible to obtain non-porous welds, and at the same time reduces the corrosion resistance of the weld in the case of non-ferrous liners.

METHOD 3—Lining installed by use of strips lapped and fillet-welded with the unexposed edges continuously welded.

Advantages

A. Weld metal exposed to action of corrosive agents is a 100% alloy weld, is not contaminated by any carbon steel or base plate material, and no weld joining the alloy material to base plate material is exposed.
B. Less overall welding exposed to attack by corrosion.
C. Strips do not have to be of exact size and strip edges do not have to be perfectly square, facilitating ease of installation.
D. Less welding required, except for method similar to this method, but welded intermittently along unexposed edges of strips.
E. Narrow strips, without punched holes, can be taken into vessel through normal size manholes.

Disadvantages

A. Will not withstand as high a hydrostatic force tending to pull it loose from base plate as will either the plug-welded or the butt-welded strip lining installations.

METHOD 4—Strip welding with the strips lapped and fillet-welded with the unexposed edges intermittently welded to the carbon steel base plate.

Advantages & Disadvantages

Same advantages and disadvantages as under Method 3 above, with the further disadvantage of not having as much strength to resist stresses between lining and base plate, and it does not completely segregate each of the individual lining strips, so that detection of leakage in a welded joint for repair purposes would be difficult after lining had been in service for any extended period of time. Therefore, whenever a lapped lining installation is indicated, Method 3 above should be used in lieu of this procedure.

METHOD 5—One-half the total number of strips used to be entirely fillet-welded to the base plate, the spacing of these strips to be such that one strip will completely cover the space left and also lap over the strips on either side enough that a fillet weld can be made which will not be contaminated by the carbon steel base metal.

Advantages & Disadvantages

A. This method has the same advantages and disadvantages as Method 3 above, with an important additional advantage over the shingle method in the sequence of labor between boilermakers and welders. The boilermakers are able to place one-half of the strips and move out until the welders have completed the welding of these strips.

Building a Modern "Cat Cracker"

Experience with Prior Units Provide Basis for Design Improvements that Cut Construction Costs and Make Possible Savings in both Operation and Maintenance

By S. R. McMURRY, Cracking Dept. Foreman,
Cities Service Oil Co., East Chicago, Indiana

DESIGN improvements in the new 14,760 b/d fluid catalytic cracking unit installed in the East Chicago refinery of Cities Service Oil Co. include less height, smaller catalyst lines, lower C/O ratio, outside catalyst stripper, slurry settler, less complicated instrumentation, and special provisions for expediting maintenance work.

The reduced height, 180 ft., as compared to 225 ft. in earlier installations, resulted in economies in foundation, structural steel and piping. The more compact unit also will make possible considerable savings in turnaround time and expense as well as in operating costs. What had been learned from previous installations regarding fluidization of catalyst and flow through the lines, together with the overall reduction in structural height, made possible the use of smaller piping in the catalytic section. The instrumentation simplification was the result of experience gained as to what control instruments were essential.

The ground layout provides an area for handling materials for either the catalytic structure or the fractionation-stabilization section. A 180-deg. trolley beam is located in the top of the regenerator. Tubular equipment on the fractionator is equipped with trolleys and beams. An open space is provided in the structure for lowering tubular equipment to the ground.

The new fluid cracker at East Chicago was processed, designed and constructed by M. W. Kellogg Co. Working closely with them in the $2\frac{1}{2}$-year project was a group of Cities Service engineers with years of experience in design and construction as well as in operation and maintenance of this type of processing unit. The unit was put on stream April 10, closely meeting the completion date set, and it lined out easily at design operating conditions.

In most instances of completion of construction on processing units of this type, there usually are a considerable number of items not quite complete, or additions are desired by the operating personnel at the last moment. The following steps taken on the East Chicago project overcame most of the problems arising from these causes:

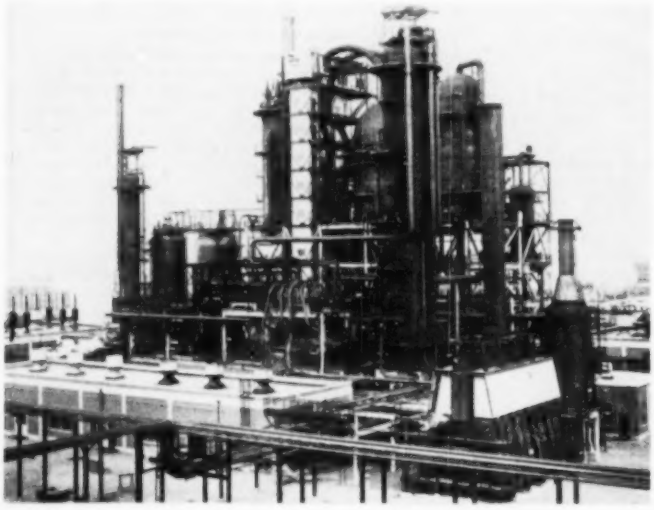
1—The Kellogg operators came on the job 30 days before the scheduled completion date and worked with the construction department in cleaning out lines, testing equipment and so on.

2—Kellogg and Cities Service personnel together made a complete survey of the unit 60 days before the scheduled completion date. All changes that were agreed upon as necessary were worked into the construction schedule, causing very little change in the finishing date of the unit.

3—A complete list of all unfinished jobs was made about 30 days before scheduled completion. This listing was revised weekly, carrying all jobs from the previous list and showing whether complete, started, percentage complete, or no work done from the previous week.

4—During the last 30 days of construction, operating and construction foremen met daily for a discussion on progress.

Some of the details of design, layout and construction of the new Cities Service Fluid unit are given in the following portion of this article.



General view of the new Fluid catalytic cracking unit at the Cities Service Oil Co. E. Chicago, Ind., refinery

Ground Layout

The plot area is 310 ft long east to west, and 225 ft. wide from north to south. A diagram is shown in Fig. 1. The north boundary contains the catalyst structure, which in turn contains the catalyst stripper, reactor, regenerator with waste heat boilers, Cottrell precipitator, and the new and used catalyst storage drums. Along the east boundary is the feed preheater furnace, steam superheater, and the building housing the control room and the blower room. The blow-

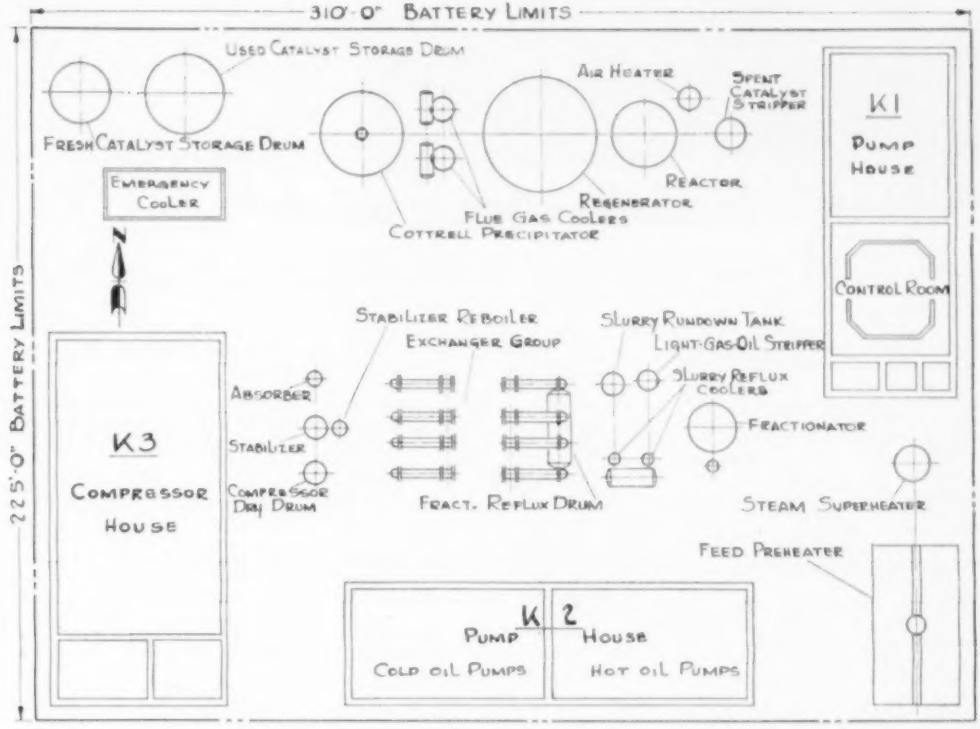


Fig. 1—Diagram of ground layout of new fluid catalytic cracking unit at East Chicago refinery, Cities Service Oil Co.

er room contains the two 2500 hp. centrifugal blowers that provide the combustion air and the catalyst flowing medium to the regenerator.

The south boundary is the hot and cold pump rooms. The west boundary contains the compressor building and the relief and blowdown system. The compressor building also houses the electrical switch room, a maintenance work room, and catalytic cracking offices.

Through the center of the plot from east to west is the fractionator, with overhead condensers, and slurry reflux coolers. The west end contains the stabilizer and gas absorber along with the necessary heat exchange and tubular cooling equipment. This layout leaves a 50-ft. wide space between the catalytic structure on the north and the fractionation-stabilization section in the center. This space allows ample room for a long boom crane to handle heavy materials to or from either structure, and also provides a means for moving material into and out of the work site.

Test borings at the site indicated the safe soil bearing pressure of 2500 lbs. sq. ft. However, due to the high concentration of loading in the catalyst structure, a settlement of 6 ins. over the next 10 years was considered possible. To prevent such an occurrence, 200 concrete piles were driven to an average depth of 90 ft. to support the catalyst structure foundations. To save time and lumber, steel panel forms were used wherever practical on all concrete form work. The use of these forms proved economically feasible on a wider range of work than at first anticipated.

The buildings were of reinforced concrete beam and column construction, with the panels built in with brick. The walls were 8 ins. thick to a height of 12 ft. Walls over this height were made 12 ins. thick for safety. Twelve-inch walls were also placed between control room and blower room, and between the gas compressor room and the switch room as a safety measure.

Unit Proper

The Fluid unit structure was built with steel beams and girders using different size piping for wind bracing. The tower structural steel was fire proofed up to the base of the reactor and regenerator by Guniting. The pipe wind braces were fire proofed in forms before being installed. This method of fire proofing proved to be satisfactory and was more economical than forming around the steel work.

The reactor was made of carbon steel with 0.219 corrosion allowance, field welded, completely x-rayed and then stress relieved after completion. As much as possible of the welding was done on the ground, even to the installation of the grid and cyclones. This method saved considerable time since there were only three horizontal welds to be made in position. Fig. 2 shows the first two sections of the reactor in place.

The regenerator is 36 ft. 6 ins. I.D. after the lining was installed. The lining was of three different types. The bottom head was made up of plastic insulation, Hexsteel Armor and castable firebrick to a depth of 3¼ in. The side walls were suspended tile over block insulation to a depth of 7¼ ins. The top head was covered with 2 ins. of high temperature block insulation which was protected by #405 stainless steel shingles bolted down with studs installed in the vessel head.

There was improvement in the cyclones installed in the East Chicago unit over those used in the earlier units. There is no flange between the cyclone and the collection hopper. (Fig. 3). This eliminates a point of

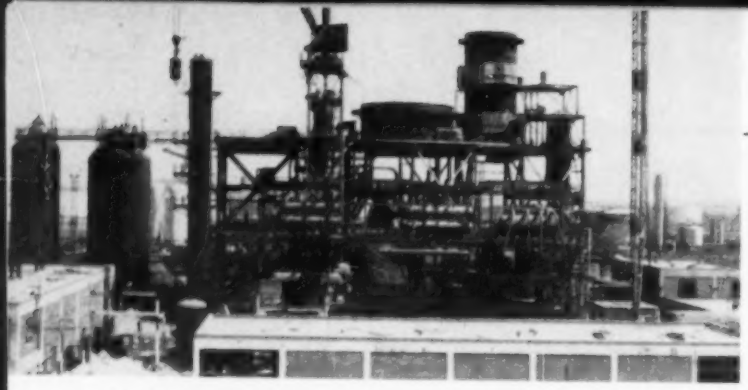


Fig. 2—First two sections of the reactor in place and being welded. Building construction, as shown in the foreground, was reinforced concrete beam and column, with built-in brick panels

catalyst erosion that caused trouble on some of the earlier units. The gas outlets weld directly into a plenum chamber which supports the cyclone directly to the vessel and connects with vapor outlet lines from the vessel. This construction eliminates the old tie-rods and supports that were somewhat of a problem on the earlier units. In both the reactor and regenerator a work platform is installed around the cyclones which should prove beneficial and time saving during turnaround.

The reactor is provided with a 50 in. manway and the regenerator a 72 in. manway to accommodate large sections of the cyclones in or out of the vessel where future repairs may be necessary.

The fractionator, a 16-ft. I.D., 120 ft. long vessel was shop fabricated and shipped by barge to the lake front at East Chicago and unloaded on special railroad cars and brought to the plant. The vessel is a fractionator desuperheater and slurry settler combined. Light gas oil, gas, unstable gasolene, and decant oil are made as products. Heavy gas oil and slurry are recycled to the reactor with the fresh feed. The trays in the fractionator, the light gas oil stripper, the stabilizer and absorber were made of stainless steel. It was felt this would result in less repair and replacement costs.

The outside catalyst stripper is about 9 ft. diam. and 30 ft. long, with the catalyst inlet about in the middle. The catalyst takeoff is low enough in the reactor to provide plenty of flexibility in bed depth. One large slide valve controls the flow of catalyst from the reactor to the catalyst stripper. The performance of the stripper has been satisfactory and, while data is not available on its overall efficiency, fewer repair problems are anticipated on the outside stripper as compared with the more conventional inside stripper.

The East Chicago unit is one of a few recently built in which each slide valve has its own hydraulic setup. The electrically driven pumps set along side the valve and are mounted over a small reservoir of oil. We believe this hydraulic system is responsible, along with the instruments, in providing our excellent results and lack of trouble in controlling the flowing media, which is fluidized catalyst. The slide valves themselves are of conventional design with some minor improvements in protection against erosion.

The Cottrell precipitator is enclosed in a cylindrical vessel with a cone bottom. The top head contains the vent stack and the insulator compartments. The design efficiency is 98.5%, and tests made with unit at design operating capacity indicated a better recovery than was estimated.

The precipitator vent stacks usually present a problem in acoustics. However, the design of the East Chicago unit is such as to eliminate most of the stack noise. This was accomplished by orifice plates, before and after the control valve, plus the addition of sound proofing on the stack wall and a cross partition of sound proofed steel inside the length of the stack. This improvement again was the result of study and experimentation on the earlier units.

Considerable time was taken in the design to place trolleys, beams, and hoists in convenient locations for handling the equipment during turnaround. There is a 360 deg. trolley on both the fractionator and stabilizer for handling valves, tray parts, and miscellaneous moderately heavy equipment.

A 180 deg. trolley beam is located on the steel work near the top and north of the regenerator. This beam is capable of hoisting heavy equipment such as slide valves and cyclones. The tubular equipment on the fractionator structure is equipped with trolleys and beams, with bracing of the structure for pulling bundles out of, or into, the shells. There is an open space in the structure where the tubular equipment can be lowered to the ground if major repairs in the shop are required.

The pumps, blowers, and compressors are provided with beams and trolleys for handling repairs requiring disassembly.

The blowdown stack is self supporting with the drum vertical and forming the lower portion of the stack.

Fire fighting and safety equipment installed at the new fluid unit is shown in Table 1.

TABLE 1—Main Fire Fighting and Safety Equipment Installed in Cities Service New Fluid Cracker

1. 1½ hose stations and fog nozzles
2. Liquid foam stations
3. Carbon dioxide extinguishers
4. Regular fire plugs on the plant fire system surrounding the plot
5. Fire blankets
6. "Air-Pac" face masks with air containers
7. CO indicators
8. Inter communication system to all parts of the catalyst and fractionator structure
9. A 150 lb. fire steam system, with smothering lines to furnaces, pump rooms, and compressor rooms, and with steam hose stations in the buildings and throughout the structure.

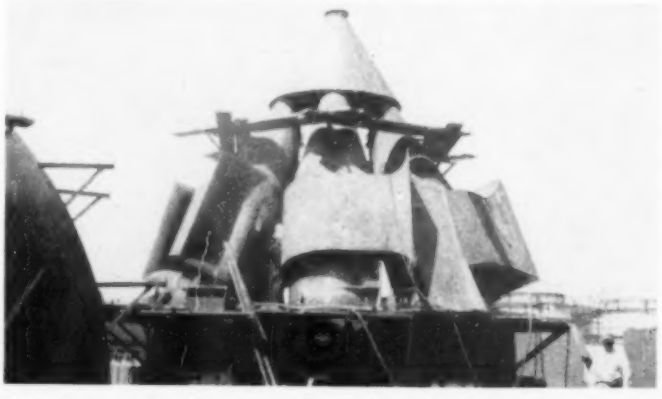


Fig. 3—Regenerator cyclones assembled and to be installed in the top head of the vessel before hoisting into the structure. Note absence of flanged connections

Operating Problems in Gas Treating For Hydrogen Sulfide Removal

By J. S. CONNORS and A. J. MILLER, Phillips Petroleum Co., Bartlesville

Many corrosion and other operating problems connected with the removal of hydrogen sulfide from natural gas are also experienced by petroleum refiners in treating refinery gases from sour crude. The treating methods described are applicable in a technical sense, although different economic factors would prevail for the refinery application. The modified iron oxide process is being used in treating natural gas where the hydrogen sulfide content of the gas is low.

This paper was originally presented under the title "Operating Problems Relating to Gas Treating" before the Panhandle-Plains Regional meeting of the Natural Gasoline Assn. of America at Amarillo, Texas, Dec. 9.

"GAS Treating" as discussed here is limited to the treatment of gas for hydrogen sulfide removal only. However, it should be noted that, where carbon dioxide also is present, many of the methods for hydrogen sulfide removal will remove carbon dioxide; and therefore, its presence must be evaluated in the selection and operation of the treating process. In general, chemical processes are employed and these may be roughly classified as either batch or regenerative operations.

Batch Type Treatment

The caustic soda and lime slurry processes are typical examples of the batch type process and are well known. These processes are not generally used in large scale operations due to the high reagent cost and the serious problem of disposing of the sulfides produced as end products. The iron oxide process is another example of the batch process and is the old standby of the utility companies in the treatment of manufactured gas. With some slight modifications this process can be adapted for use in the treatment of natural gas at fairly high pressures in cases where the volume of gas to be treated is not large and where the hydrogen sulfide content is low. This process has an advantage over the caustic soda or lime slurry processes in that the treating reagent is not appreciably affected by the presence of carbon dioxide in the gas.

In the modified iron oxide process, wood shavings impregnated with iron oxide and called "Iron Sponge" are placed on trays inside a pressure vessel and the gas is passed downward through the beds.

The iron sponge is available as a commercial product which contains 9 pounds of iron oxide per bushel of material. In actual operation, iron sponge is not effective unless it is kept moist and slightly alkaline. Therefore, when the sponge is placed in the chamber approximately one pound of soda ash is added for each bushel and the whole mass is thoroughly dampened before any gas is treated. The moisture content is critical and the bed must be kept damp while in operation.

It is also important that the gas temperature be held above approximately 80° F. At lower temperatures the reaction velocity is considerably decreased and the beds will cease to treat effectively long before they are spent.

When the gas to be treated contains no oxygen the theoretical life expectancy of the beds is the removal of 5.76 lbs. of hydrogen sulfide per bushel of iron sponge. In actual practice this is seldom obtained and for design purposes a life expectancy of approximately 50% of the theoretical appears more practical. The spent beds may be regenerated by first *thoroughly soaking* them with water and then removing them from the chamber. The wet material removed is spread out on a concrete slab in a layer 12-15 in. deep and turned over with a fork once a day for several days. The oxygen of the air oxidizes the iron sulfide back to iron oxide with the formation of free sulfur.

Precautions must be taken to keep the regenerating mass damp at all times, otherwise the heat of reaction will cause the shavings to catch fire. Such regenerated material may be re-used several times, however the formation of fines due to handling will increase the pressure drop in the process when the regenerated material is again placed in service. In cases where pressure drop is critical, it is our practice to mix equal volumes of new iron sponge with regenerated sponge rather than to use all regenerated material.

When oxygen is present in the gas to be treated life expectancies even greater than theoretical can be obtained, since the oxygen will allow for simultaneous regeneration along

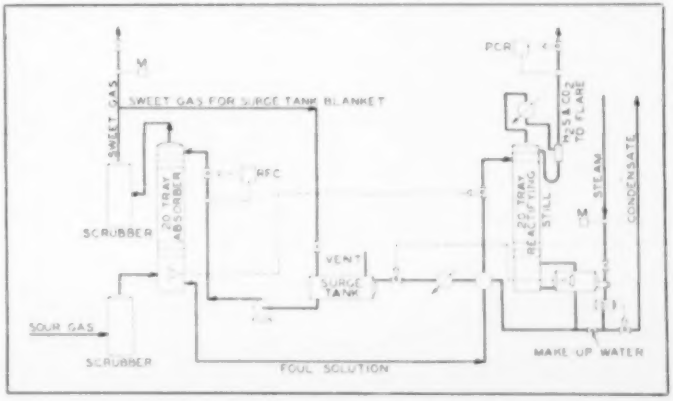


Fig. 1—Flow diagram of an amine gas treater

with hydrogen sulfide removal. In this case, it may be necessary to remove the beds from service and discard them before they are spent because the formation of free sulfur in the regeneration reaction will result in cementing the sponge bed into a hard compact mass making removal difficult and pressure drop excessive.

Regenerative Processes

In the treatment of natural gas where the quantity of hydrogen sulfide to be removed is high the regenerative processes are usually employed. There are many of this type, those commonly used in this country have been the soda ash, the phenolate, the tripotassium phosphate and the amine processes.

The soda ash process was the pioneer of this type treater. However, they all employ the cycle of absorption and stripping but differ in the absorption media.

For purposes of brevity, the discussion of operating problems on this type of treater will be limited to those of the amine process treaters only, a typical flow diagram of which is shown in Fig. 1. Phillips is currently operating approximately 20 such units varying in size from treaters with a capacity of 1 MMscfd to more than 160 MMscfd, operating on gases with a wide variation in hydrogen sulfide and carbon dioxide concentrations. Table 1 shows some data concerning these units.

Treater A, our first treater of the amine type, was placed in operation about 10 years ago treating approximately 4000 Mscfd of a mixture of propane and ethane using a 10-15% solution of MEA (Monoethanolamine) in water as the treating agent. Since our experience with this unit has furnished a pattern for future guidance, it may be well to discuss its variable history at some length.

The treater was operated with excellent treating efficiency reducing the hydrogen sulfide content of the gas from 600 gr./100 cu. ft. to less than .05 gr./100 cu. ft. However, since we also desired to partially dehydrate the gas stream, after 8 months of operation, the treating solution was changed to a mixture of approximately 75-90% DEA (Diethanolamine) and MEA and 10-25% water. Treating efficiency decreased slightly and the degree of dehydration expected was obtained. 250 psig steam at 404° F. was used to heat the kettle and the kettle temperature was 308°-318° F. Corrosion occurred in the heat exchangers and these were replaced after a total service life of about 19 months.

Operations were adjusted so that the kettle temperature was maintained at approximately 290°-300° F. and a program of solution analysis was inaugurated, the results of which are shown in Table 2. The second set of heat exchangers had to be replaced after 8 months of operation. The stainless steel heating element was found to be corroded, and some of the areas where the tubes were welded to the tube sheet were leaking. The still kettle at the liquid level was also corroded.

It was believed that the three most likely causes of the corrosion were as follows:

1. Carbonyl sulfide present in the gas.
2. Carbon disulfide present in the gas.
3. Overheating of the solutions.

The first two were found not to be present and the entire solution was discarded and a new solution containing approximately 40% DEA, 35% DEG (Diethylene glycol) and 25% H_2O was added. The steam used to heat the kettle was changed from 250 psig live to 100 psig exhaust steam. Kettle temperatures were held below 265° F. The unit was operated on this basis for several years without any noticeable additional corrosion. Thereafter, it was decided that, since dehydration was no longer required, the practice of adding glycol could be discontinued.

At the present time the solution is 20-25% DEA and 80-75% H_2O. The kettle temperature is approximately 240° F. It is interesting to note that, with the exception of the replaced heat exchangers, this unit is operating with all of the original equipment intact.

Treater B was placed in service about 8 years ago as a combination treater and dehydrator using a solution containing approximately 50.0% DEA, 5% MEA, 35% DEG and 10% H_2O. The operators were instructed not to allow the kettle temperature to exceed 280° F. 250 psig live steam was used to heat the kettle. The addition of DEG was discontinued soon after the start-up and the treater operated on a low MEA-50% DEA mixture in water. However, after 10 months of operation, the heating element had to be replaced and it was believed that the maintenance of a low liquid level in the kettle allowing exposure of the top section of the bundle was the cause of the corrosion. The bundle was replaced.

In the following 3½-year period, many of the tubes developed leaks and had to be plugged. During this period the solution was gradually changed, replacing the DEA with MEA. The addition of an organic chromate inhibitor to the solution was also tried. Approximately four years ago the heating element was again replaced and the steam supply to the element was changed from 250 psig live steam to 40 psig exhaust steam. To date, we have no further corrosion on this unit.

Treater H was placed in operation slightly over 4 years ago treating the same gas as treated by Treater B. The operating conditions were decidedly different. Treater B had been operated with a kettle temperature of 238° F. while Treater H, due to operating the still at elevated pressure (35 psig), had a still kettle temperature of approximately 290° F. After two years of operation, the unit was in very poor shape. There had been numerous leaks in the foul solution piping, heat exchanger heads, in the bottom 1/3 of the absorber and in the top of the still.

Metallurgical examinations using magnaflux disclosed that the leaks were caused primarily by stress cor-

TABLE 1—Data on Amine Gas Treaters

Capacities from 1000-160,000 Mscfd

Treater	Type Gas Treated	Acid Gas Content H_2S Gr./100 CF	Acid Gas Content CO_2 Mol %	Treating Solution	
A	Ethane Propane	600-1,200	.025	DEA	20-25%
B	Residue Gas	600	4.2	MEA	15-20%
C	Residue Gas	1,400	1.5	MEA	15-20%
D	Residue Gas	450	4.0	MEA	15-20%
E	Residue Gas	980	4.0	MEA	15-20%
F	Raw Gas	70-90	0.3-0.6	MEA	15-20%
G	Residue Gas	1,400	1.5	MEA	15-20%
H	Residue Gas	600	4.2	MEA	15-20%
I	Residue Gas	4,200	3.5	MEA	15-20%
J	Residue Gas	1,700	4.8	MEA	15-20%
K	Residue Gas	1,700	4.8	MEA	15-20%
L	Residue Gas	1,700	1.0	MEA	15-20%
M	Residue Gas	75	0.8	MEA	15-20%
N	Raw Gas	70-90	0.6	MEA	15-20%
O	Raw Gas	65	0.15	MEA	15-20%
P	Synthesis Gas	...	17.0	MEA	20-25%
Q	Raw Gas	30	.2	MEA	15-20%

TABLE 2—Analysis of Amine Solutions from Treater A

	Date				
	7-5-40	9-4-40	1-6-41	6-6-41	9-15-41
Amine as MEA by Kjeldahl, Wt. %	57.0	56.7	52.3	47.9	50.8
Amine as MEA by Titration, Wt. %	55.7	55.2	48.8	43.3	41.0
Other N_2 Compounds as MEA, Wt. %	1.3	1.5	3.5	4.6	9.8
MEA by Van Slyke, Wt. %	15.2	9.7	5.5	3.2	5.1
DEA by Calculation, Wt. %	67.9	80.0	80.5	76.9	78.8
Water by Bidwell Sterling	...	...	11.6	14.0	7.9
Total	84.9	89.7	97.1	94.1	91.8
Unaccounted for	15.1	10.3	3.9	5.9	8.2
Iron Capacity in PPM	...	...	1,850	2,750	8,000

Fig. 2—Corrosion cracks on inside of vessel near tray support ring weld

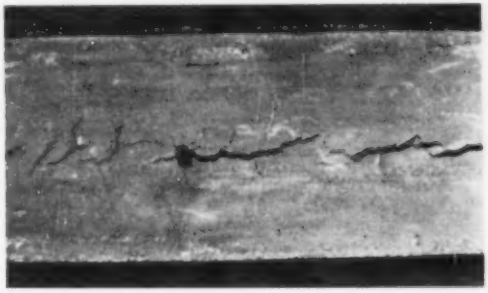


Fig. 3—Corrosion cracks in head of vessel opposite the skirt weld

rosion with considerable general corrosion in certain areas. In addition to the points where the equipment was actually leaking, numerous other cracks were found. The areas affected by stress corrosion were all in the vicinity of welds but not in the weld metal. The solution when analyzed was found to be mildly corrosive.

The vessels were sent to the shop where all cracked areas were repaired and they were then stress relieved. New piping was fabricated and the operating conditions were changed so that all exhaust steam (40 psig) was used in the kettle elements and the kettle temperature was held at approximately 240° F. Since this has been done there has been no further evidence of corrosion.

Treater C was started approximately 8 years ago using 40 psig exhaust steam in the element and with kettle temperature held at 240° F. This treater has been in continuous operation since that time without appreciable corrosion. Treater G operated on the same gas as Treater C with operating conditions similar to those of Treater H, also had to be rebuilt after approximately two years operation. It is interesting to note that since it was impossible to repair the absorbers, these were replaced with secondhand riveted vessels which were seal welded and not stress relieved. Upon changing the operating conditions to approximate those of Treater C and upon reclamation of the corrosive solutions there has been no further sign of corrosion on this unit. Figs. 2 and 3 are photographs showing the general appearance of the stress corrosion cracks developed in Treaters G and H.

When the gas to be treated contains oxygen as well as hydrogen sulfide there will be a considerable formation of amine thiosulfate in the treating solution. This amine thiosulfate is not regenerated in the ordinary manner and will eventually build up sufficiently so that most of the amine is not available for hydrogen sulfide removal. When this occurs the amine can be freed by the addition of small quantities of soda ash to the solution. The addition of soda ash results in the formation of sodium thiosulfate and amine carbonate, the latter being decomposed in the still and the amine solution regenerated in the normal manner.

When the quantity of sodium thiosulfate is deemed excessive (in cases when MEA is used as the treating solution) the solution can be reclaimed by simple redistillation in a semi-continuous process with very little equipment.

In the operation of the cyclic process treaters, a small quantity of water is continuously lost from the solution in the regeneration stage. Thus, any non-volatile impurities present in the water used to make up the treating solution will tend to concentrate and eventually deposit out in the form of scale. Therefore, it is our practice to use only steam condensate in the original solution and to provide facilities so that steam condensate can be added semi-continuously in order to keep both the solution strength and volume at the desired levels.

In general, it may be said that in all treaters treating raw gas, considerable operating difficulty is caused by foaming in the absorbers. It is believed that this foaming is caused by the formation of soaps by the reaction of the alkaline solution with minute traces of naphthenic acids present in the raw gas. This difficulty can be eliminated by the addition of small quantities of an antifoam agent, such as commercial oleyl alcohol or stearyl alcohol. These alcohols due to their limited solubility should be added into the pump suction to insure sufficient dispersal into the treating solution.

All gas treater solutions carry small quantities of iron sulfide in suspension. Over a period of time these particles grow and become large enough to settle out. This action results in the formation of a black sticky mass which effectively plugs liquid level control connections, gauge glass connections and will in time interfere with heat transfer. It has been found that if approximately 10% of the circulating solution is continuously filtered the solutions can be kept in their original state and practically all black residue eliminated. One very effective filter is the Infilco Stellar filter using diatomaceous earth as a filter aid.

Another source of impurities in the solution which may cause trouble is the readily volatile compounds which are soluble in the solution. Where these are found to be present they may be eliminated by discarding the water which is normally condensed from the still overhead vapors and returned to the system as reflux. When this is done fresh condensate may be added to the still as reflux to compensate for the condensate, containing the volatile compounds, discarded.

Summary

It has been our experience that the principal operating problem on the cyclic gas treater is corrosion. In general, it may be said that this corrosion is due to impurities present in the solution. The most general sources of impurities are as follows:

1. Corrosive compounds resulting from the breakdown of amines due to excessive temperature.

2. Corrosive compounds formed by direct oxidation of the amines.

3. Corrosive compounds present in the gas being treated.

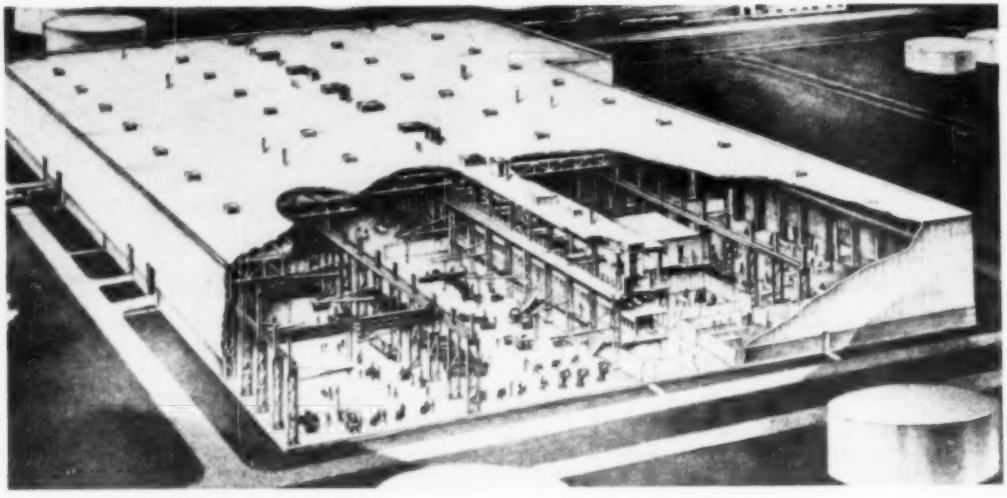
These impurities may be classified as follows:

1. Solids—removed by filtration.

2. High boiling soluble compounds—removed by redistillation.

3. Low boiling soluble compounds—removed by discarding the condensate normally recovered from the still overhead vapors.

The authors wish to acknowledge the assistance of Phillips Petroleum Co. treating engineers in collecting some of the information presented.



Cut-away drawing of first section of Humble's centralized shops building at Baytown refinery

200,000 b/d Plant Centralizes Shops

A GOAL of complete centralization of all mechanical crafts in the Baytown refinery of Humble Oil & Refining Co. is being realized with the recent completion of the first section of a huge repair and maintenance shops building. The structure will replace presently scattered facilities and will bring under one roof all the mechanical departments of a complete refinery covering 2700 acres of ground and running over 200,000 b/d of crude oil.

The completed building, in three sections, will be 720 ft. long, 308 ft. wide, and 44 ft., 8 ins. high. The presently finished section is 312 ft. long; the second section will be 165 ft. long, and both are the same width, 308 ft. The second section is under construction with completion expected early in 1950, at which time work will begin on the third section.

Floor area in the portion now finished is 94,270 sq. ft., and several hundred people will work there. It has four work bays, each 72 ft. wide and 46 ft. high, separated by walls and partitions into separate shops. A bay down the center 20 ft. wide and four floors high will house offices, lockers, utility lines, and storage space.

Overhead cranes traverse the full length of each bay. Fixed cranes will handle local lifting and moving jobs. Modern shop equipment of all types will be installed. Each shop will be made as nearly soundproof as is possible. Lighting is with both mercury vapor and incandescent lamps in each fixture. Telescoping platforms, 35 ft. high and capable of holding two men, will be used for changing bulbs.

The building will be entirely without windows and will be air conditioned to close specifications for both temperature and humidity during all seasons. Heat loads in various parts of the building will differ, and the building will be zoned to meet this requirement. Fiberglas insulation in the walls and ceilings of all three sections of the proposed structure will help maintain the specified summer and winter temperatures.

During summer months the inside temperature will not exceed 78° F., when the outside dry bulb temperature is 95 and outside wet bulb temperature is 80. Relative humidity will not exceed 50% with an outside wet bulb at 80° F. In winter, the temperature is to be maintained at a minimum of 72° F., when the outside dry bulb is 20° F., and a relative humidity of at least 30% will be maintained when the inside temperature is not over 72 and outside dry bulb is 32° F.

The air conditioning equipment to serve all three sections will be installed in the second section. One 550-ton and one 1100-ton York centrifugal compressor are now being installed in this section, and room is provided for two additional 1100-ton units. Freon No. 22 is employed as the refrigerant.

The walls of the completed section of the centralized shops building are of insulation and asbestos siding on a 7-ft. brick base. The roof is made of galvanized metal lath, glass wool blankets, 4-in. light rock slab and a layer of asphalt felt.

The Houston offices of H. K. Ferguson Co. designed all three sections of the proposed building and erected the first section. The W. S. Bellows Construction Corp., Houston, has the contract for the second section, now under construction. The Otis Massey Co., Houston, has the contract for installing Fiberglas in the first and second sections.

As part of the improved plant maintenance program at the Baytown refinery, all the mechanical crafts—pipefitters, machinists, welders, insulators, carpenters, instrument men, electricians, bricklayers, painters, blacksmiths, tinners and others, will be brought together under one roof. Thus there will be less delay when repair work has to pass through several different shops.

Modernizing and centralizing the shop facilities is Humble's plan for keeping mechanical work at Baytown in step with expansion and improvement all over the refinery. The plant has grown so large and its operations so complex that the old decentralized shops were inadequate to serve the plant's requirements as fast and efficiently as necessary under today's operating conditions.

Five Unique Design Features Installed In Ohio Oil's Modernized Refinery

By WILLIAM C. UHL
Equipment Editor

FIVE new and unique design features in processing and auxiliary equipment have been incorporated in Ohio Oil Co.'s recently completed multi-million dollar refinery at Robinson, Ill. They are:

1—A continuous oxidation unit for processing vacuum tower bottoms to asphalts of several specific grades, as desired.

2—A system for high recovery of usable oil from plant wastes, employing a rotary precoat vacuum filter in addition to conventional API separators, one of the first such installations made in any oil refinery.

3—An improved monolithic lining procedure for the Fluid catalytic cracking unit regenerator, aimed at obtaining increased onstream time and lower overall structural weight.

4—Provision of an especially designed device for minimizing erosion at the control valve on the Fluid unit flue gas stack.

5—A permanent installation of a water-fog system in the major processing areas to give increased protection in the event of fire.

The chief products at Robinson are motor gasolines, heating oil, liquefied petroleum gas, residual fuel oil, kerosine, Diesel oil, and asphalt. Present processing procedure is diagrammed in the simplified flow chart in Fig. 1.

The plant charges about 27,500 bbls. of Illinois crude oil daily to the new two-stage distillation unit, and about 15,000 b/d of gas oil to the new Fluid catalytic cracking unit.

The additions made to the plant during the expansion program include a Universal Oil Products Co. designed crude unit, the Fluid unit, a catalytic polymerization unit, gas recovery plant, and gasoline treating unit. Also included are the cooling water system, waste disposal and slop oil recovery unit, TEL blending house, and major changes in the power plant. The refinery went on stream early last summer.

Existing equipment before the building program began consisted of an 18,500 b/d crude unit, four modified Holmes-Manley thermal crackers, each with a gas oil charge capacity of 2000 b/d, and a Kellogg combination distillation and cracking unit of 2500 b/d capacity.

Asphalt Processing

The continuous method of ashpalt manufacture as such is not new. Many companies, including Ohio Oil, have revamped existing equipment for that purpose. Usually crude tower bottoms are pumped from an intermediate storage tank through one or a series of old horizontal batch type stills while air is blown through some perforated pipes on the floor of the stills. Close control of product quality is very difficult in such an operation, as is also close control of fire hazards.

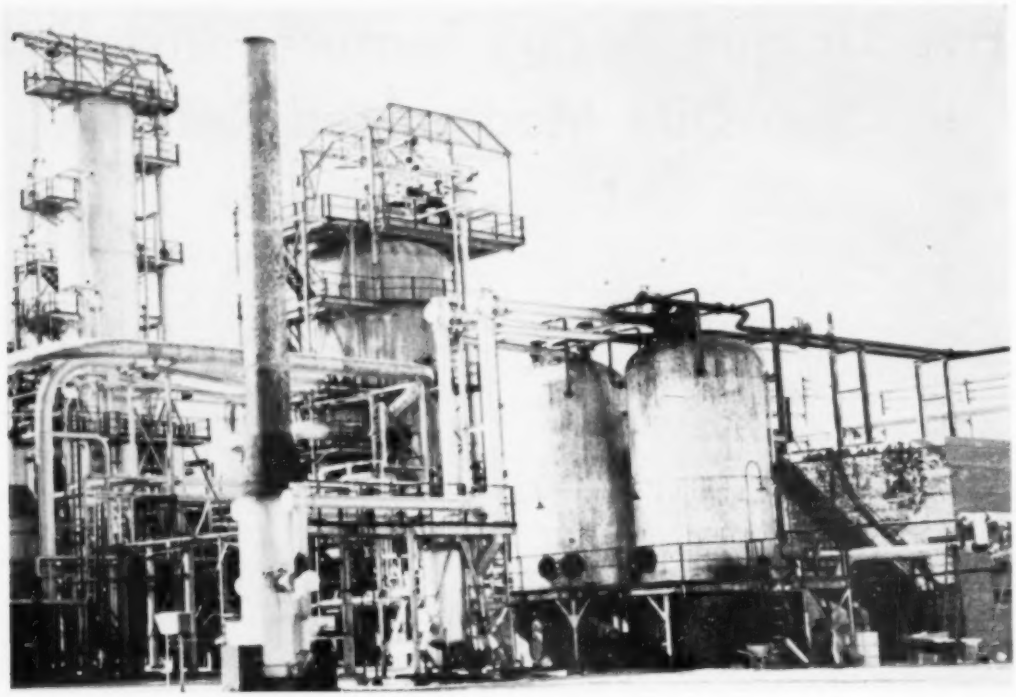
Fig. 1—Simplified flow diagram of major process flow at Ohio Oil Co.'s Robinson, Ill., refinery

In the new arrangement at Robinson, crude still vacuum tower bottoms flow directly through cooling coils to the oxidizing vessels. There, air is blown through a carefully designed jet system developed by the Turbo-Mixer Corp. The simplified flow chart, Fig. 2, illustrates the operation of this process unit. High efficiency in oxidation is obtained because of the path of the air streams through the upwardly flowing oil. The air, at about 7 psig., enters the blowing stills at approximately 160° F., its temperature being raised by the heat of compression from the rotary blower.

Each oxidizing vessel is a 12-ft. diameter by 19-ft. deep tank with 15 ft. of charge depth. Each 42-in. mixing unit is equipped with a 20 hp. gear-motor drive. The calculated starting load is 15.5 hp. and the running horsepower during oxidation is expected to be 10.5 to 11.

The impeller on each mixer receives from 600 to 800 cfm. of air. The design capacity is 5500 gals./hr. at 30° F. rise, or 1600 gph. at 100° F. rise.

In operation, the hot asphalt is sucked to the underside of the impeller, discharged centrifugally through the stationary deflecting blade ring, and forced in a downward path by the hood on the ring. (See Fig. 3.) Air from the feed pipes impinges on the target and enters the impeller between the flowing



Asphalt oxidation unit. The two large cylindrical vessels at the right are the oxidizers. Two large lines going from tops of these vessels through the vessel at the center to the stack at the left are vapor lines

streams of asphalt. As the asphalt and air mixture is discharged into the stationary ring blades, the air is broken down into fine bubbles and violently scrubbed into the asphalt. This gives a high rate of transfer of oxygen across the interface.

The Turbo-Mixer is a patented design which the manufacturer states has been used for all types of absorption operations for many years, and has shown high efficiency.

In a typical operation at Ohio Oil, tower bottoms at about 710° F. are pumped through the first cooling coils, where the temperature is lowered to 450° F. The oil then passes through the blowing stills in series, being raised to 490° F. in the first and 500° F. in the second. Then it is pumped through the final coils, which lower the temperature to about 300° F., and thence to storage. All lines are insulated and steam traced.

Three different products can be produced from the bottom of the vacuum column: (1) 16-17° A.P.I. gravity flux, (2) 80-90° F. melting point asphalt, and (3) 100-102° F. melting point asphalt. The type of bottoms product is dependent on the absolute pressure in the vacuum column and the reduced crude heater transfer temperature. Melting points higher than 100-102 are made by use of the oxidizer.

Overhead vapors from the blowing still pass through a combination water wash and seal tank to a burning stack. Steam is injected into the top of each still to form a steam blanket above the asphalt level, which reduces the tendency toward flashing and coking on the top head.

Each pump throughout the area is provided with a spare. A piston type ram pump is used to clean out asphalt lines with Diesel oil after they are taken out of service. A ram pump is also used to unplug lines in which asphalt has partially solidified.

The two asphalt stills can be op-

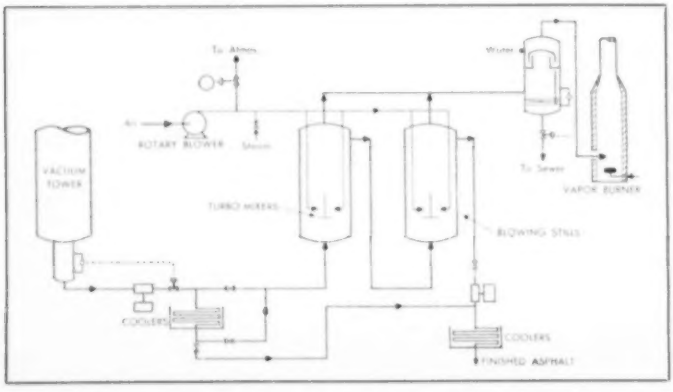
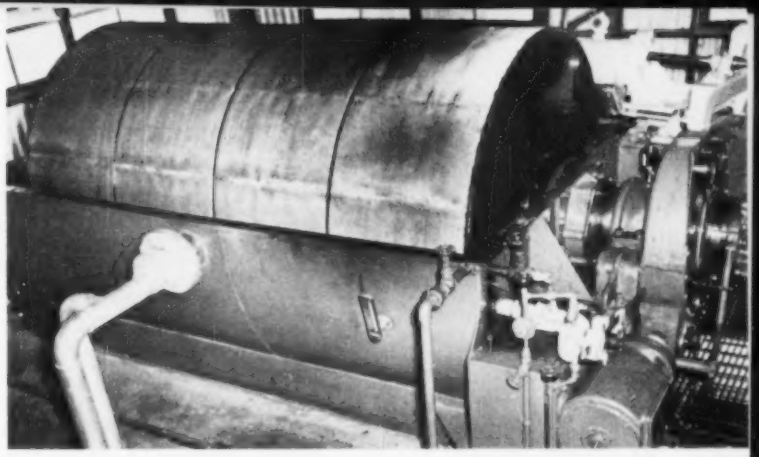


Fig. 2—Schematic flow diagram of the continuous asphalt oxidation unit

Five Unique Features



Right: the rotary precoat filter in the slop oil recovery system, showing stainless steel screen on which the cake is collected

erated singly, in series, or in parallel. Thus far, Ohio Oil has not used the parallel arrangement.

Waste Oil Recovery

Based on the principle of using a precoat type, vacuum filter to break the oil-water emulsion in refinery waste, Ohio Oil's slop oil recovery system obtains an almost 100% reclamation of usable oil along with a very low oil content in the effluent water stream. Illinois state waterway agency tests have shown the refinery effluent stream contains 2 ppm. and less of oil.

The system is illustrated in the simplified flow diagram in Fig. 4. As operated by the company since it went into service in May, 1949, skimmer sump accumulations from the API separator are pumped periodically to one or the other of the two 500-bbl. mixing tanks, picking up an injection of Tretolite on the suction side of the pump.

The oil separated by the Tretolite is removed by a swing line, and the bottom emulsion then is pumped directly through an Oliver Precoat filter, where the emulsion is broken. Filtrate passes on to the 2000-bbl. settling tanks, from which the pure, reclaimed oil is easily removed and returned to the plant. Recovered oil normally is used as part of the feed to the catalytic cracking unit. Water phase from the settling tanks joins drain streams from the mixing tanks and is returned to the inlet side of the API separator.

Two settling basins of conventional design are in the line of flow on the effluent side of the separator. Purified waste water then passes through a 1¼-mile sewer to natural waterways and ultimately to the Wabash River.

Company engineers estimate that between 50 and 60% of the oil recovery is accomplished by the treating chemical and the balance of 40 to 50% is obtained by the filter. Flow rate through the filter averages about 15 bbl./hr., but records show it varies from as low as 5 to as high as 40 bbl./hr. Operation of the system is not a day-in-day-out proposition, but rather is done whenever sufficient sludge is accumulated, about 3 to 3½ times per week.

One application of diatomaceous silica filter aid—fourteen 50-lb. bags—will last for a full run of between 24 and 28 hrs. This figures to a little less than 2 lbs. of filter aid per bbl. of throughput when running at the 15 bbl./hr. rate.

Most oil-water emulsions collected in a refinery become stabilized by dirt particles. Particles of dirt are surrounded by a drop of water, suspended in an oil phase. Heating and chemical treatment will result in a partial breakage of this emulsion, but seldom is the entire volume broken.

Considerable work has been done in the past by filter manufacturers toward development of a system for

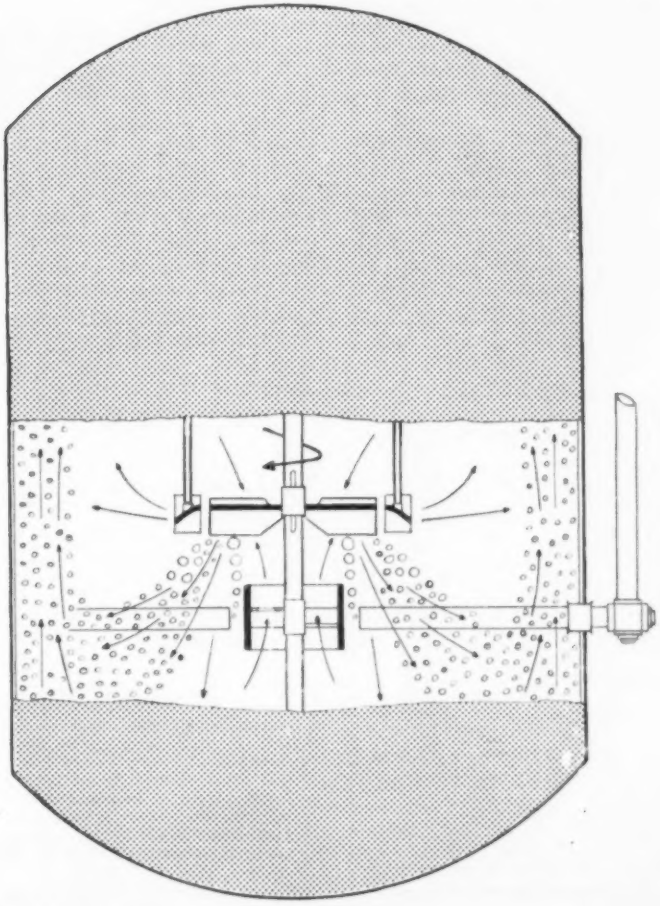
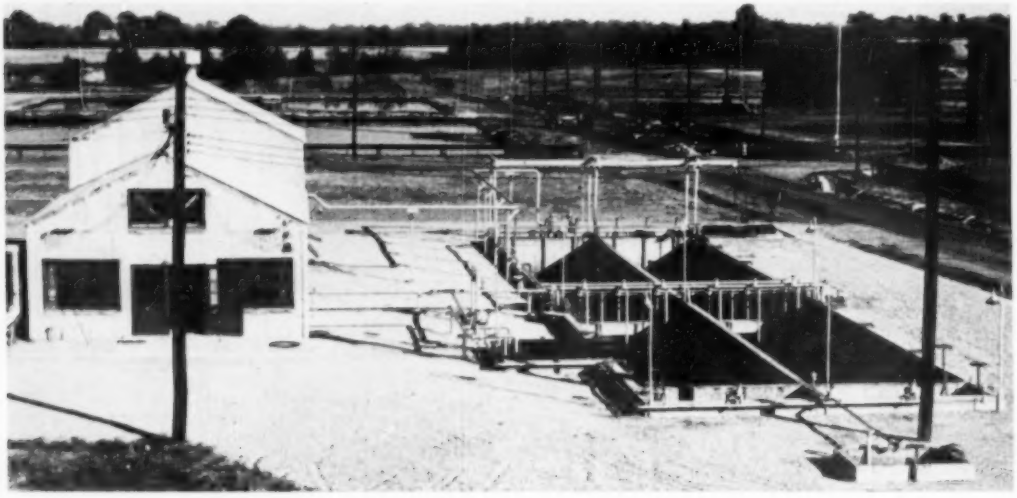


Fig. 3—Left: details of the Turbo-Mixer device used in the asphalt oxidizers. Bubbles indicate flow of air; arrows that of the vacuum tower bottoms



Aerial view of the slop oil recovery area: API separators at right; filter and pump house at left; two large settling basins in background, behind building

utilizing pressure filters; however, the filter cycles were found too short for practical purposes. The Oliver United Filters, Inc. design of a vacuum type, rotary, precoat filter was found to be the answer to the problem.

With this equipment, a 2½ to 3-in. thick coat of diatomaceous silica filter aid is deposited on the vacuum drum by slurrying the filter aid in water or oil. A knife mechanism advances about 0.0035 in. per revolution of the drum, shaving off a thin film of the precoat and the collected cake. This means that a clean surface is continuously presented to the oil emulsion, thus eliminating the problem of short cycles and permitting continuous operation, only one pass through the filter being required.

The Ohio Oil Co. unit is a 5-ft., 3-in., diameter by 8-ft. long drum, containing approximately 130 sq. ft. of filter area. The construction is of fabricated steel. The drum is covered with stainless steel wire cloth.

The installation at Robinson, the first full-scale unit in any oil refinery, has been giving operating results consistent with those of pilot plant units under test at several other refineries, except for variations in flow rate, which depend entirely on the specific gravity of the oil and the amount of dirt. Oliver engineers report a complete break of the emulsion is being obtained in all cases, with a single pass through the filter.

By means of cross manifolding, not shown in detail in Fig. 4, Ohio Oil also charges the API separator bottoms to the precoat filter for dewatering and de-oiling.

The slop oil recovery system includes, in addition to the API separator, a structural steel, Transite covered building, which houses the filter, the various pumps, and storage space for the treating chemical and filter aid. A permanent installation of foam lines and nozzles to all parts of the separator provides complete protection in the event of fire. The oil recovery unit was built by J. F. Pritchard Co.

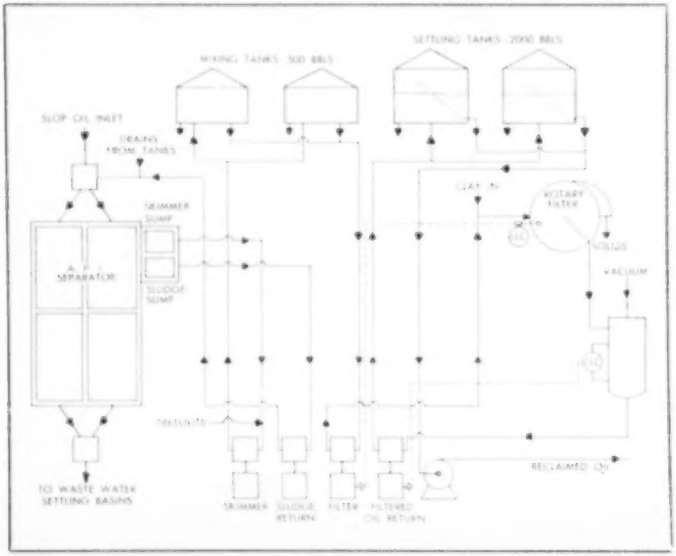


Fig. 4—Arrangement of equipment employed in slop oil recovery system

Regenerator Lining

Reduced skin temperatures on the Fluid unit regenerator shell are evidence that an improved procedure by which this vessel was lined will result in increased service life, Ohio Oil engineers believe.

Spot checks with "Tempil" sticks of temperatures of the outside face of the regenerator have indicated the desired results of 335 to 350° F. when inside temperatures range up to 1100° F.

The composite lining, developed by

Universal Oil Products Co., is shown in Fig. 5 and the accompanying photograph. It covers the entire lower section (bottom cone) and the side walls of the carbon steel regenerator, up to the point where the diameter tapers inwardly to the upper tube sheet, or cyclone support. Above that point, the lining comprises 3-in., high-temperature, magnesia block insulation protected by stainless steel shingles held in position by bolts which are welded in place.

An essential feature of the composite lining is the use of "high chairs," commonly used in conventional reinforced concrete construction. In the Ohio Oil unit, these chairs are of U-shaped, ¼-in., plain steel wire, and have an overall height of 3½ in. They are used in the so-called continuous form—welded on 12-in. centers to a 10-ft. length of ¼-in. wire. The legs of the chairs are welded in a horizontal position around the circumference of the vessel, on 12-in. centers on the vertical.

Also welded to the vessel wall are the vapor-stops, consisting of continuous steel strips, ⅛ x 2 in., formed to the proper radius, and spaced on 4-ft. vertical centers, as shown in Fig. 5.

The procedure for applying this composite lining follows:

1. The surface is cleaned by sandblasting to remove all rust, mill scale, welding slag, and other foreign materials.

2. All vessel openings are closed with tapered hardwood plugs, lightly coated with grease.

3. All heavy structural members joined to the shell are covered with pitch or tar to prevent bonding with the lining, so as to provide the flexibility required by temperature changes.

4. A 3½-in. layer of a 1:6 mixture of Lumnite cement and Vermiculite aggregate is applied by means of a cement gun, starting at the bottom of the vessel and proceeding circumferentially upward.

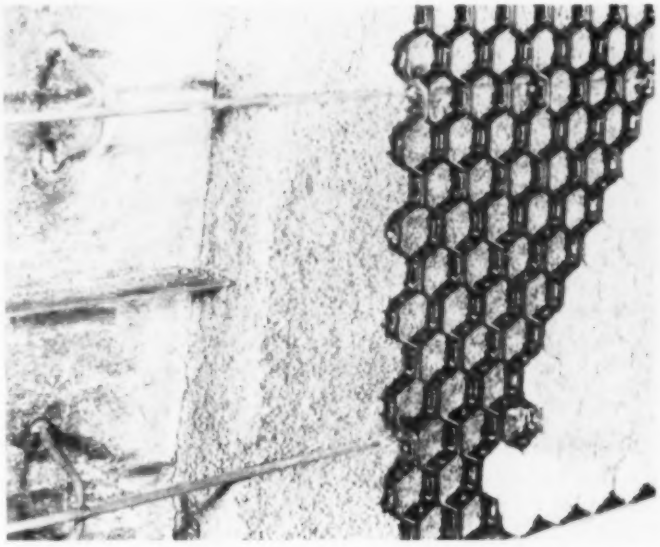
5. The Lumnite-Vermiculite lining is cured by conventional water spraying for at least 24 hrs., and then air-dried at atmospheric temperature for at least 48 hrs. The temperature is then increased at about 40° F./hr. to 230-250° F., and is maintained at that level for at least 48 hrs., or until it is evident that all moisture has been expelled.

6. The top faces of the chair bars are fully exposed, and hexagonal steel grating, 14-ga. x ¾-in., is tack-welded to the bars on approximately 6-in. centers.

7. Refractory castable is applied by means of a cement gun to a thickness of ¾ in., filling the openings in the hexsteel grating, flowing into its slots and behind it. This castable is made of Lumnite cement and suitably calcined fireclay. The inner layer is thoroughly wetted before application of the refractory castable.

8. The refractory castable is cured and dried out in the same manner as the insulating material. The entire lining is then tempered by raising the temperature within the vessel to about 1000° F. at about 80° F./hr.

A distinct advantage of this composite lining, in addition to its good insulating properties and abrasion resistance, is its extremely light weight, desirable in a process vessel of this size.



UOP's model of the improved lining for Fluid unit regenerator: showing four stages in its application, from left to right

Minimize Stack Valve Erosion

Rapid erosion of the control valve in the regenerator flue gas stacks has in the past been attributed chiefly to the excessive pressure drop, usually from 15-17 psi. in the flue gas steam generator to atmospheric at the stack outlet. This problem is overcome at Robinson by an

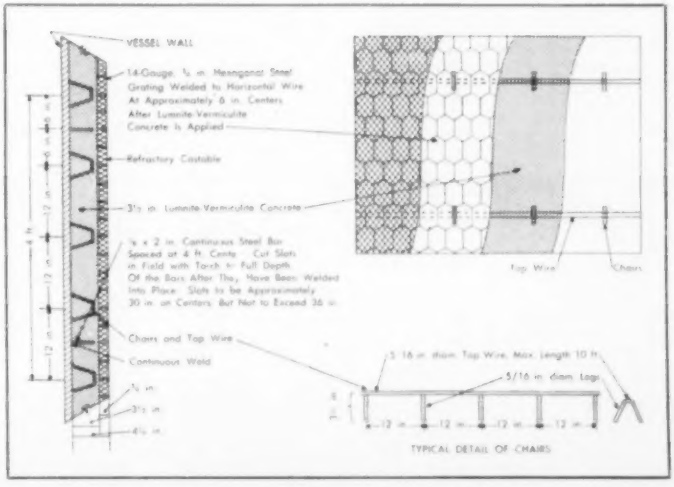
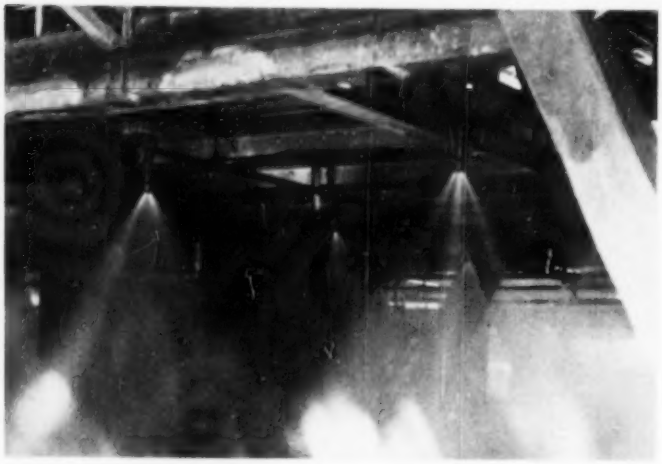

VESSEL WALL
14-Gauge, ¾ in. Hexagonal Steel Grating Welded to Horizontal Wire At Approximately 6 in. Centers After Lumnite-Vermiculite Concrete Is Applied
Refractory Castable
3½ in. Lumnite-Vermiculite Concrete
⅛ x 2 in. Continuous Steel Bar Spaced at 4 ft. Centers - Cut Slots in Field with Torch to Full Depth Of the Bars After They Have Been Welded Into Place. Slots to be Approximately 30 in. on Centers, But Not to Exceed 36 in.
Chairs and Top Wire
Continuous Weld
¾ in.
3½ in.
4¼ in.
Top Wire
Chairs
5/16 in. diam. Top Wire, Max. Length 10 ft.
5/16 in. diam. Legs
12 in.
TYPICAL DETAIL OF CHAIRS

Fig. 5—Details of the monolithic type lining in Fluid unit regenerator



A portion of the water fog system on an upper level of one of the processing units during a test on the nozzles

expansion chamber, the second such designed and installed by UOP. A similar piece of equipment has been giving satisfactory service in a UOP Fluid unit at the Detroit refinery of Aurora Gasoline Co. (See PETROLEUM PROCESSING, Sept. 1947, pp. 670-672).

The chamber provides a means for reducing the pressure drop in three successive stages of 3 psi. each, so as to obtain the optimum of 6 psi. across the control valve. A vertical, cylindrical, carbon steel vessel, 5 ft. in diameter and 32 ft. in height, it contains three perforated, horizontal "restriction" grids, spaced at intervals of 6, 8, 8, and 6 ft., measuring from bottom to top. Each plate contains 80 two-in. diameter holes. Groups of these holes are blanked off on each plate, the number blanked off being determined by conditions and pressure drop requirements.

A flue gas by-pass line has been provided in the Robinson installation to guard against any possible failure or blockage in the main stack.

Water Fog Installation

Unique as a method of fire protection is the permanent installation of a water fog system in the major processing areas at Ohio Oil's refinery.

A complete network of piping covers each unit with fog type nozzles, located at various levels so as to penetrate to the points of chief potential danger and also to provide a coolant for the important structural members, which might become weakened from excessive heat.

The major piping arrangement is shown schematically in Fig. 6. Details of manifolding on each individual processing unit are too complex for reproduction here. There is one valve for each of three sections in each of the three areas, and one push button switch at the valve location.

In case of fire, the responsible person at the area in question opens the proper valve and pushes the button. This starts the 1250 gpm. fire pump, located in the plant water system pump house. The switch in the process area will not turn off the pump. That can be accomplished only by the switch at the pump itself. The fog system water circuit is independent of any other plant water lines.

The 1250 gpm. available from the pump is not enough, of course, for the entire fog system at one time. Ohio Oil engineers feel chances are remote for a fire which would demand a deluge at all points in the process area, although it is planned to install improved impellers on the pump and utilize a heavier motor which would boost output to about 1700 gpm. This capacity will meet the highest possible demand from any single one of the nine sections.

The three sections at the crude area are all concentrated on the atmospheric unit with none on the vacuum still. Maximum demands are 242, 1100, and 144 gpm. on each section. There are 97 fog nozzles of six different types. Some are placed around the lower walls of the main tower. Others provide protection to main structural members—in addition to concrete reinforcing. Most of them are near the ground level, with a few on the second level.

In the cracking area 225 nozzles of six different types are installed. Maximum demands on each section here are 1566, 402, and 1368 gpm. The highest point this system reaches is about 100 ft. above grade, just below the bottom head of the reaction vessel. There are other nozzles on down along the stripper supports and around the regenerator.

Maximum demands on the three sections in the light ends area are 690, 415, and 483 gpm. A total of 129 nozzles of three types are used. On the poly unit, the highest point reached is about 42 ft. Nozzles at that location protect a poly feed surge drum, normally containing C_3's and C_4's. In this area, particular attention has been paid to protection of many of the light ends vessels. The stabilization section includes protection up to a height of about 28 ft., so as to cover a number of condensers. The highest level reached on the gas concentration unit is about 30 ft.

The fog system does not constitute the sole fire protection at Robinson. Conventional steam smothering lines are installed at the furnaces and considerable portable extinguishment equipment is employed, including dry chemicals and foam.

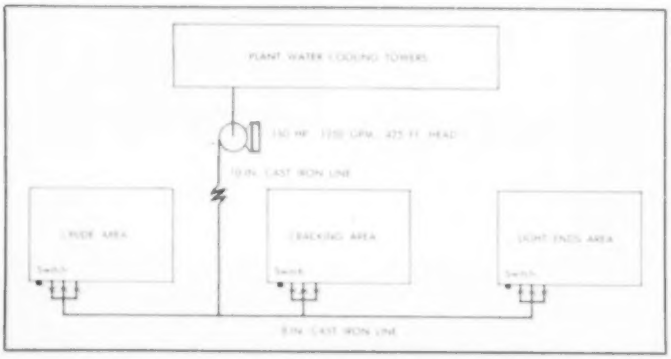


Fig. 6—Major piping arrangement for the water fog system

Application of Ultrasonic Energy Feasible in Chemical Processing

By WILLIAM C. UHL
Equipment Editor

HIGH frequency sound—beyond the range of human hearing—can now be utilized, it is reported, in full-scale processing equipment to speed up such reactions as distillation, extraction, polymerization, oxidation, coagulation, and the like. Heretofore, the uses of this so-called ultrasonic energy have been limited in capacity to the test tube and laboratory stage.

Equipment exhibited publicly for the first time at the 22nd Exposition of Chemical Industries in New York, Nov. 28 to Dec. 3, demonstrated the feasability of extending the size of ultrasonic operations to production scale. This has been made possible through the development of especially formulated barium titanate ceramic materials. These ceramics permit the use of electrical current to produce high frequency sound waves which can be made to emanate uniformly into a desired area or focal point. The supersonic energy can be obtained at greatly reduced rates of electrical input, as compared to that resulting from quartz crystals, used previously in the various laboratory types of supersonic generators.

"Colossal" Shaking

The chief function of supersonic energy is to subject chemical reactions to what might be termed "colossal" shaking. The vibrations set up by a supersonic generator, or transducer, reach an acceleration of one million times per second. As a result, reactions which normally require several hours to complete might be accomplished in a matter of seconds or minutes.

Officials of the Brush Development Co., Cleveland, who developed the commercial equipment and are organizing to market it under the tradename "Hypersonic Generators," explained that the new ceramic has a low impedance in comparison to quartz.

This means that a very low voltage can be applied to obtain the same acoustical energy that would require a very high voltage with quartz. For example, quartz type generators necessitate an input voltage of 2000 or more, whereas ceramic elements will operate satisfactorily in the range of 50 to 100 volts.

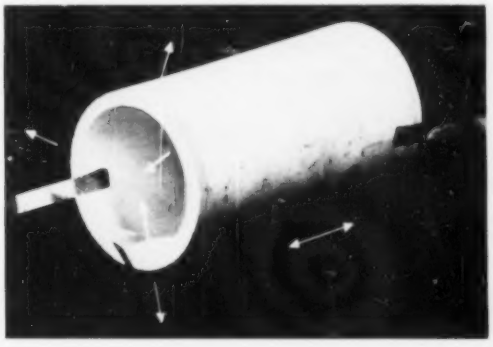
Prime source of ultrasonic force is found in so-called piezoelectric devices. Quartz and other similar crystals have such properties. This means their crystalline structure produces controlled vibrations on the application of electric current. Practical applications have involved the use of natural quartz crystals processed to the desired shapes and dimensions. However, quartz is a scarce material and particularly expensive in the large shapes required for industrial scale use of supersonics.

Wartime research at the Titanium Alloy Mfg. Co. (now a division of National Lead Co.) revealed that certain ceramics containing titanium showed many of the required piezoelectric properties of quartz. Further work at Brush Development Co. has led to successful techniques and methods of producing finished barium titanate ceramics in almost any shape or size. Several typical ultrasonic generator "elements" of this new ceramic are shown in the photographs. Of these, the tube-shaped and the dish-shaped elements will represent the most effective possibilities for ultimate use in chemical processing units, it is believed. The tube shape will lend itself particularly well to continuous processes wherein reactants flow through piping, or large cylindrical vessels, and the like.

Some Problems Still to be Met

As yet, many chemical engineering requirements in the field of ultrasonics have not been adequately satisfied. Chief problems in addition to the proper size generator include discovering the best operating conditions, designing accessory equipment, determining the methods and techniques to be employed and circulating the existing knowledge on the subject. The Brush Development Co. feels it has a good start on the answers to some of these phases to the problem. They are building pilot-plant size models of the "Hypersonic Generator" and have established a Hypersonics division to aid individual manufacturers in further development of satisfactory commercial supersonic equipment.

The American Institute of Chemical Engineers has also shown interest in the field. Leading the way in making available the present knowledge on ultrasonics the AIChE has scheduled a special series of 10 technical papers on this subject, to be presented during the first five months in 1950. Dudley Thompson,



Two shapes in which new ceramic "elements" for "ultrasonic" generators are being made. White arrows indicate direction of flow of the high frequency sound waves

assistant professor of chemical engineering at Virginia Polytechnic Institute, has been named to supervise this series of special papers. Professor Thompson presented his own paper on the subject at the 42nd annual meeting of the Institute in Pittsburgh during the week following the New York Chemical Exposition.

Where Will It Fit?

Just where the supersonic generator will fit in the field of petroleum processing operations is a difficult question to answer as yet. From all indications, it would seem to have considerably greater possibilities today because of the Brush Development Co. work in developing the new ceramic. In reply to PETROLEUM PROCESSING, a number of oil company authorities have indicated that the Hypersonic development is significant and merits further exploration. One spokesman stated:

"The production of large barium titanate transducers by Brush is no doubt a great step forward in the field of ultrasonics. It is reasonably certain that these transducers have all the advantages claimed for them such as greater output, variety of shape, low cost (probably), and much lower voltage operation (100 to 200 volts as against 2000 to 6000 volts). However, it is still difficult to talk in terms of petroleum processing applications for two reasons.

"The first is that it has not been shown that ultrasonics will really do a great deal process-wise; and the second is that the energy costs are still extremely high. A given amount of electrical energy from the power company still costs 6-7 times as much as an equivalent amount of heat from cheap fuels, and added to this cost must be the cost of converting commercial power to high frequency power.

"It would appear that one would have to be able to do something really remarkable with ultrasonics to justify this cost, or else do it to a very expensive product which could absorb this high cost. As far as laboratory problems go, the new transducers have some advantages over quartz, but the big advantage of large power handling ability is not so important in these applications.

Ceramic Permit Large Units

"In other words, it is still too early to talk about using these transducers in the field, but their availability does make it at least possible to do large scale ultrasonic work, if the proper application could be found. This was not possible before the development of the barium titanate transducers."

Another petroleum technologist agrees that the idea is technically sound but questions whether the equipment can be developed and operated competitively with other modern engineering approaches.

A research director with a chemical company closely associated with the petroleum processing field pointed out that the development is certainly one of significance but one which requires much further work before it can be considered a good tool to use in the industry. He explained that it is likely the ultrasonic generation equipment would seem to have application in lube oil manufacture because of its ability to promote extraction.

Agreeing to its possibilities in lube oil manufacture was a professor of chemical engineering at a midwestern technical school, who had previously been associated with a major oil company in process engineering. He believes ultrasonic energy might have a place in extraction techniques, although that would require considerable experimentation. Of more immediate usage would be its potential employment in blending of lube stocks. In addition, he believes it might serve in fluid catalytic reactions. He is convinced it has a place in future petroleum processing operations.

Refinery Interested

The chief chemist of a medium-sized refinery in Illinois told PETROLEUM PROCESSING his plant is very much interested in ultrasonic equipment. They have built a small, one kilowatt generator and are now experimenting with various materials with which they hope to line metal pipe, which would then be used for some type of continuous processing. The new barium titanate ceramic material appears the most promising, he said, although at this stage of development many problems remain to be solved. His company has not selected any specific processes in which they hope to apply ultrasonic energy. Rather they have been trying it out on everything possible.

In summary, it can be recognized that the very high speed which the use of ultrasonic energy can bring to a chemical reaction is a factor of great importance. It is the one factor which must be considered in any study of this new tool when the cost of operation and the original investment is brought into the picture. In short: if speed of reaction is a necessity to the overall requirements in a plant, then the higher cost of using supersonics can be considered favorably. Specific applications for this new type equipment remain to be found by further research.

Fischer-Tropsch Catalyst

Another new development which created wide interest at the Chemical Exposition was the exhibit of two products by General Aniline & Film Corp., carbonyl iron powder and the liquid, iron pentacarbonyl. The carbonyl iron powder has proved effective experimentally as a catalyst in the Fischer-Tropsch reaction.

The liquid, iron pentacarbonyl, has been suggested as a substitute for tetraethyl lead as an anti-knock agent for motor fuels. It has all the usual properties of TEL fluid, however, company engineers pointed out that as yet it has a number of important drawbacks that would certainly limit its present possibilities in this field. It has a strong tendency to deposit iron on cylinder walls, to create fouled spark plugs, etc. In addition it is a very toxic material requiring careful handling (See "Toxic Properties of Refining Chemicals Listed by API Medical Committee," PETROLEUM PROCESSING, October, 1948, p. 969-972.)

Extraction Is Simplified

The multiple stage liquid extraction process can now be reduced to a unit operation comparable with distillation as a result of a new piece of laboratory equipment demonstrated the first time publicly at the Chemical Exposition by Otto H. York Co. Called the York-Scheible Extractor, it provides for continuous countercurrent, liquid-liquid extraction requiring a large number of stages. It comprises a tower provided with a number of extraction stages, each stage having a mixing section and a tacked calming section in which the liquid phases are separated. (See "What's New," Item 9, PETROLEUM PROCESSING, Nov., 1949, p. 1271.)

The equipment can be applied, it is stated, to the solutions of such problems as the separation of: close-boiling mixtures, azeotropic mixtures, non-volatile mixtures, heat-sensitive mixtures, and isomers.

How It Operates

In carrying out fractional liquid extraction, a fresh heavy solvent introduced at the top of the column serves to rectify the light solvent extract moving upward; this action being similar to that produced by liquid reflux in a distillation column. Similarly, the light solvent entering at the bottom of the column performs a stripping action on the heavy solvent extract flowing down the column; an action similar to that produced by reboil vapor in distillation.

A 1-in., 14-stage laboratory-size extraction unit, complete with all auxiliary equipment is available from stock from the fabricator. Larger pilot and plant scale equipment can be built to order in any diameter and any number of extraction stages. The 1-in. model can handle up to one gal./hr. depending on the properties of the liquids being handled. It is said to give better than 100% stage efficiency and heights equivalent to a theoretical stage as low as 2 in.

Control Point Location and its Effect On Fractionator Column Operation

By K. D. UITTI, Universal Oil Products Co.
Presented before Instrumentation Symposium, Texas A. & M. College, Oct. 12-14, 1949

Temperature conditions in a laboratory fractionation column were investigated in a study to determine the optimum control point for the instrumentation setup. Calculations were made with various feed compositions. The effect of holding a constant reflux rate was considered.

MANY instrumentation setups have been used for the control of fractionating columns, with varying degrees of success. A very commonly used method is to control the reflux rate according to the setting of a temperature-sensitive device in some point in the column, holding a constant rate of heat input to the reboiler. Another accepted method is to fix the reflux at a constant rate by a flow controller, holding some temperature in the column constant by letting it vary the heat input.

In any fully automatic column control instrumentation of these types, it is always necessary to provide for at least two basic items, the heat balance and the fractionation level. It is to the latter factor that this particular paper directs its interest.

Both of these minimal instrument requirements must be servomechanisms of the closed loop type. By fractionation level is meant the degree of purity to which the column separates the products. A heat balance alone does not assure a given desired degree of separation, since the sum of the heats supplied by the feed, reflux and reboiler can be easily adjusted to equal the sum of the heats withdrawn in the overhead vapor and bottoms at any reflux ratio or temperature levels in the column.

The fractionation level is fixed when the reflux ratio is fixed and certain temperature is held constant for any given feed composition and column pressure. It is necessary to set both of these independent variables. An example on a multicomponent column will show why this is true. Suppose a column feed is composed of propane, butane, and pentane. A reflux ratio, of, say, twice the feed rate will make a reasonable separation between propane as overhead, and butane-pentane as bottoms, or between propane-butane mixture as overhead and pentane as bottoms. Unless a temperature is specified somewhere in the column, the fractionator is given no instructions as to where to cut.

The calculations which were performed for this work are concerned with the selection of the best instrumentation setup for a given column. The results of the work done for the system selected here should not be considered general, but are presented to indicate a method of solving for the effects of control point location or choice of servomechanisms on the product quality.

It is not within the scope of this paper to treat of time-lag in the process, although the importance of this factor is not to be ignored. No general method of solving the time lag in a transient wave of composition change through the decks of a column has been published.

Deck Temperature Curves

For all the calculations made in these investigations a fractionator having 18 theoretical decks was chosen, with the feed being introduced at a definite fixed point in the column, $7\frac{1}{2}$ theoretical decks from the top. The feed in all cases was the two component mixture—propane-butane. The column pressure was 200 psig.

At a constant feed composition and with various reflux ratios, a series of calculations were made to determine which deck, if any, changed in temperature the most. It is similar to a case where recording pyrometers are installed in the liquid on every deck, and when the reflux ratio was varied, the temperature records were compared to ascertain which deck changed the most. Such a record may be seen in Fig. 1. Of course, in cases where the reflux ratio is the highest, the overhead product purity was the highest. Hence, the curves are an indication of the temperature curve that would result for different product purities. The curves in Fig. 1 do not show the difference of deck temperatures, however, but when for a given plate the curves are each subtracted from the curve for 99% product as a reference curve, the record shown in Fig. 2 results.

Fig. 2 shows that there are two decks in this column which change in temperature more than any other decks. They happen to be the fourth deck and the 13th deck from the top for this particular feed composition, and as seen in the figure, they happen to be in the middle of the top section of the column and the bottom section of the column.

From the general nature of the system, it is a fair conclusion for fractionation of similar pairs of liquids in binary mixtures, such as in the petroleum industry, that these maximum ΔT decks will always appear in the middle of the top and bottom sections. It so happens that in this case, the temperature change for the bottom section is greater than that for the top section. The situation could easily be reversed, however, for columns of different feed compositions and feed locations, so that this aspect of Fig. 2 is not a generality.

It is a fortunate thing, too, that the maximum ΔT value for one product purity lies at the same deck as that for another product purity; that is, that the 94% product has its maximum at the 13th deck, and that the 98% product has its maximum ΔT also at the 13th deck. The maxima do not drift for different reflux ratios.

From Fig. 2, it will be reasonable to come to the conclusion that if a temperature controller were to be used in the column it should be located at one of these "maximum ΔT" decks. Since for the range of product purities considered, the change in the bottom section control deck is as much as 22°, and that in the top section 10° it would be wise choice to put the temperature bulb or pyrometer on the 13th deck, or in the bottom section. If it were to activate the reflux pump, most instrument engineers would be loath to accept the process lag through the 13 decks plus the condenser. Hence, it would be far more feasible to make the tem-

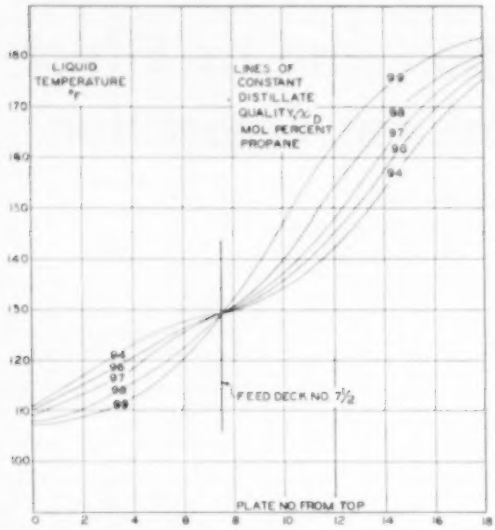


Fig. 1—Plate-temperature curves for the system: propane-isobutane at 200 psig. in a fixed column with feed composition $-x_F = 65\%$ propane

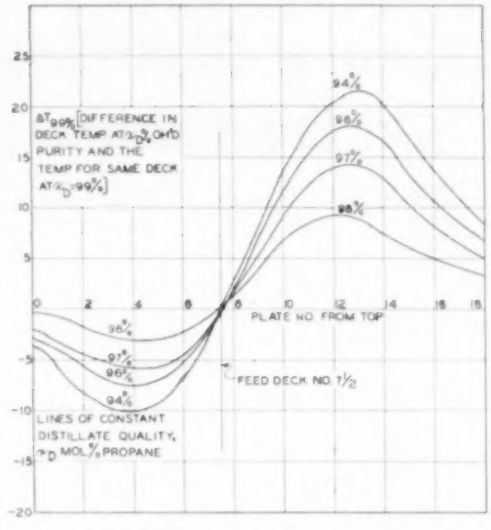

$\Delta T_{99\%}$ [DIFFERENCE IN DECK TEMP AT x_D OF D PURITY AND THE TEMP FOR SAME DECK AT x_D = 99%]
94%
96%
97%
98%
PLATE NO. FROM TOP
FEED DECK NO. 7½
LINES OF CONSTANT DISTILLATE QUALITY, x_D MOL % PROPANE

Fig. 2—Change of given deck temperature with overhead composition for propane-isobutane at 200 psig. with 65% propane in feed and variable reflux ratio

perature device control the heat input to the reboiler. The fractionation level is then determined if the reflux rate were fixed.

This is, of course, determined by the product purity desired and the difficulty of making the separation. Likewise, there may be reasons why the temperature device could rather have been put in the fourth deck from the top, actuating reflux rate, and providing for the proper reflux rate by installing a flow controller on the heating medium to the reboiler.

There is another type of maximum change of temperature in a column. This is so widely spoken of as the proper position of a control pyrometer that it was considered worthwhile to investigate it for merit. This type of temperature difference is what one would get if he took readings of thermometers on every deck, noting the difference in temperature between two successive decks. For other product purities, the same operation is performed. Fig. 3 is a representation of the calculated results of such a case. It indicates that there is no systematic relationship between this type of ΔT and product purity. The peak moves to different decks with different reflux ratios.

Effect of Constant Temperature on Intermediate Deck

Following along the lines of the prediction just made that the fourth deck may be a good control deck, from inspection of Fig. 2, a series of calculations were made, now with various feed compositions, but otherwise on the same system. It is in fact one of the very reasons for providing a column with automatic control—to make the necessary changes incident upon feed composition changes. The effect of holding rigidly constant the temperature on the fourth deck may be seen from Fig. 4. These curves serve to verify the observed facts in operating plants, namely, that reasonably good overhead product purity control is achieved by holding this intermediate deck temperature constant.

The full instrumentation visualized here consists of a temperature point in the fourth deck controlling the reflux rate, with a fixed heat input to the reboiler. Note that a rather unexpected result is obtained. The overhead becomes leaner in the light component as the feed becomes richer in the light component, a fact not readily deducible from superficial "common sense" reasoning.

There are two disadvantages to this kind of control. If the feed composition changes widely, the reflux ratio changes widely. In some columns operating near full capacity, the two- or three-fold change in reflux rate may be sufficient to flood the column. Wide variations in reflux rate such as this will cause difficulties in the column pressure control because of the changes in condenser temperature and in flow through the overhead lines.

The other disadvantage is in the fairly large variation in bottoms product purity. This is a direct result of holding a constant heat input rate to the reboiler while changing the reflux rate, allowing more of the lighter material to leave the bottom of the column when the feed increases in concentration of the lighter component. The reflux ratio must drop if the fourth deck temperature really were held rigidly constant. Note that under these conditions, as the overhead gets worse in quality, so does the bottoms.

In these cases, nothing has been said of the temperature of the feed. The calculations were all performed for feeds at such temperatures that the vapor pressure is always 200 psig. (the column pressure). A certain amount of control could be achieved by superimposing on this system a feed temperature controller actuated by some device which would indicate the feed composition. For a binary, any property, such as index of refraction, specific gravity, or vapor pressure would suffice, but for multicomponent systems, the matter becomes almost hopelessly complicated.

In general, the servomechanism to be used here would be one which would make the feed colder as the feed becomes lighter. This would tend to offset the effect of feed composition on bottoms product quality. The reason for this is that the colder feed would make a larger demand for reboiler vapor. The resulting increased stripping thereby increases the bottoms purity.

A very important advantage in this type of control is that whereas we have spoken of the binary system—

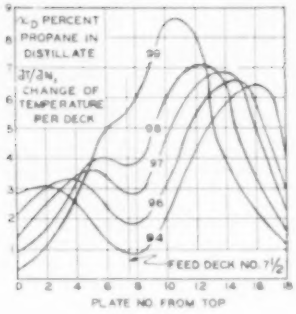
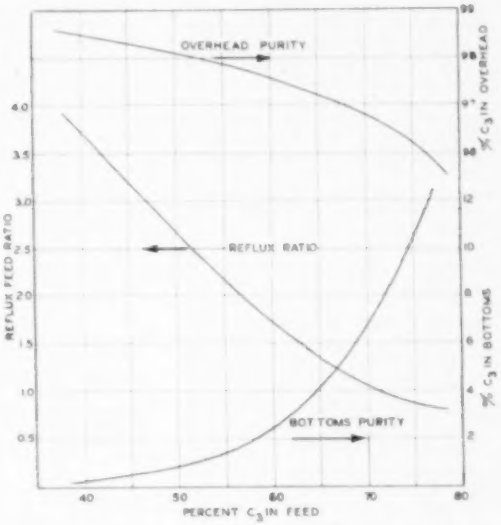


Fig. 3 (left)—Derivative curves from Fig. 2: differences of temperature between successive decks for fixed column with 65% propane in feed

Fig. 4 (right)—Effect of maintaining constant temperature on fourth deck for propane-isobutane at 200 psig. with variable feed composition and variable reflux ratio



propane-butane—in practice we never have such an idealized case. There is always a certain amount of material lighter than propane in the feed in any commercial application. This material, ethane for example, has the effect of lowering the boiling point of the binary on all of the decks in the column. It is particularly noticeable on the top deck, and less so on successively lower decks.

Now, if the ethane content is always small but variable in amount, which is certainly the usual case, no controller placed on the top deck (or in the vapor line) can be set at a fixed temperature so that the butane content of the product can be controlled to a definite minimum. This is because only a very small change in the amount of ethane in an ethane-propane-butane mixture is needed to make a large change in the butane content. Therefore, a controller placed a few decks down in the column, where the concentration of ethane has been drastically reduced, is in itself a wise recommendation.

Limits of Product Purity

Examination of Fig. 4 indicates that if the fourth deck temperature were held rigidly constant there are two fixed limits of product purity, below and above which no purities are possible. When the propane content of the feed is very low, the product purity is about 98.5% propane, and when the feed is nearly all propane, the product attains a minimum purity of about 96%.

The underlying reasons for this are not entirely obvious. The explanation calls for a detailed description of the McCabe-Thiele method of calculating these fractionations. While the methods of calculating the degree of fractionation are today entirely the stock-in-trade of a chemical engineer, it may be well for the instrumentation engineer to borrow from their field.

The details of the McCabe-Thiele calculation shown in Fig. 5 shows that, when the feed composition is continually decreased in propane content, a value is reached, about 39.4% propane in the feed, where the internal reflux ratio (liquid-to-vapor ratio) has increased to such an extent that the operating line approaches the 45° diagonal in the region near the control deck. Since the control deck temperature was fixed in this series of calculations, the fourth deck composition was automatically fixed.

This means that the fourth step must always be made so that it coincides with that composition, the operating line then drawn in such a way that the feed composition always occurs at deck No. 7½. Below the feed composition of 39.4% propane, quite wide variations in feed composition produce very little effect on the position of the operating line at the con-

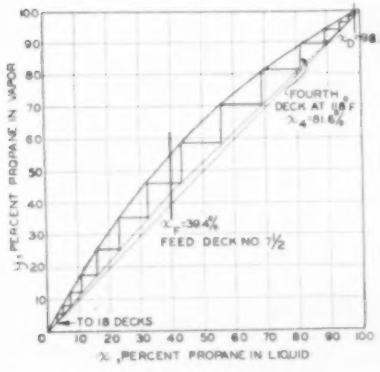
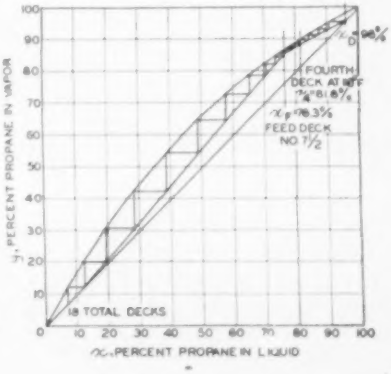


Fig. 5 (left) — McCabe-Thiele diagram showing maximum distillate quality possible in fixed column with fourth deck temperature maintained constant

Fig. 6 (right)—McCabe-Thiele diagram showing minimum distillate quality possible in fixed column with fourth deck temperature maintained constant



trol deck. Hence, a maximum purity of distillate results. In this case, it was 98.5% propane.

It is likewise shown, in Fig. 6, that when the feed is increased in propane content, still holding the fourth deck temperature constant and still feeding on deck No. $7\frac{1}{2}$, the slope of the operating line becomes so low that a pinch region is formed. This is the situation very near the condition of minimum reflux. Only small composition changes are achieved per deck in this pinch region. The operating line then intersects the 45° diagonal at a minimum value of distillate purity of about 96% propane. Below this value no product purities are possible. It is, as it were, a sort of guaranteed minimum product quality. Examination of Figs. 5 and 6 shows that the operating line pivots about a moving point on a line of 81.6% propane, the control deck composition in this case.

It should be emphasized that these maximum and minimum composition values are not immutable. They hold only for the one selected control deck temperature. Of course, greater product purities are attainable by changing the fractionation level, viz., by changing the control deck temperature. The effect of changing the control deck temperature is seen in Fig. 7.

Constant Reflux Rate

The effect of holding a constant reflux rate was considered. This instrumentation was discussed in our opening paragraph. It has been used very widely in practice. The conditions visualized for these calculations consist of the same system and the same column as before, with varying feed composition but of constant feed rate. These are the conditions met with in reality. A temperature controller on the reboiler sets the fractionation level and makes the decision as to what components will be separated at our predetermined constant reflux rate.

Constant reflux rate calculations for this series amounts to the same thing as constant reflux ratio when based on the feed. It can be roughly proved that one should expect a rather good control of product purity by holding constant reflux-to-feed ratio. If one made a series of McCabe-Thiele plots with varying feed compositions for a column of constant total number of decks and feed deck location, a plot of the reflux-to-distillate ratio against feed composition would approximate roughly an equilateral hyperbola:

$$R\,x_F/D = C$$

Since the feed composition in anything like essentially complete fractionation is nearly equal to the ratio of the distillate rate to the feed rate, or

$$x_F = D/F$$

the equations can be combined by eliminating x_F and finding that

$$R/F = C$$

which states that reflux-to-feed ratio is independent of feed composition, and that reflux-to-distillate ratio varies tremendously with feed composition for the same degree of separation. Reference to a reflux ratio in terms of the distillate has no meaning without specifying the feed composition.

A series of feed calculations were made to determine just how much the product quality really does vary with feed composition at constant reflux-to-feed ratio. The results are shown in Fig. 8. The plot shows that fairly reasonable control is possible. The advantage in this method is that the liquid and vapor rates in the column, being more nearly constant, make pressure control much easier.

Although not shown on the plot, the bottoms product quality varied much less than in the case where the fourth deck was held constant. The bottoms product varied from approximately 1% propane to 4% propane over the total range of the plot in Fig. 8. Compared with Fig. 4 for the temperature control method, whose variation was from about 0.2% propane to 14.5% propane, the control is good.

This method of control, using constant reflux rate, presupposes that the temperature controller on the reboiler can be reset according to the feed composition. If this were necessary, it would invalidate this control method somewhat. However, there is some consolation in the fact that since the bottoms product changes so little in composition, the temperature setting need only be changed very little, if at all.

All column control problems are as complicated as they are only because the feed composition varies and there appears no simple way to reset the controls on a column by a signal from the feed composition.

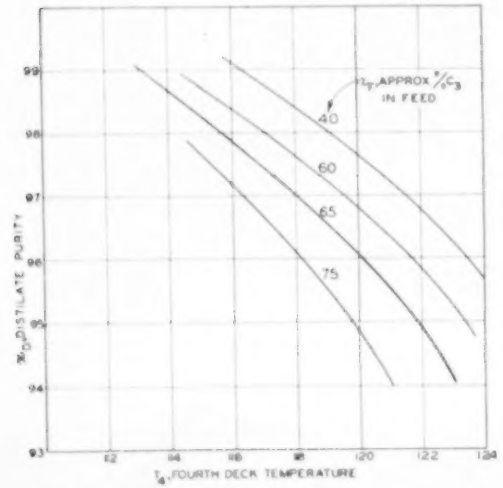


Fig. 7—Effect of direction of change of fourth deck temperature on distillate quality with variable reflux ratios and feed composition

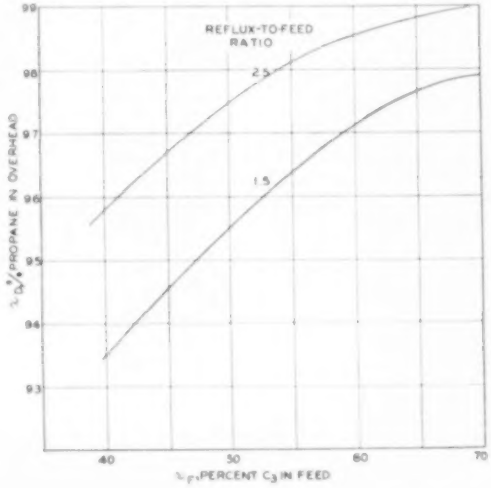


Fig. 8—Effect of maintaining constant reflux-to-feed ratio using fixed column for variable feed composition

REMODELED PLANT IS SHOWPLACE

Modernization Program at Texas Refinery Includes Picture Window for the Control Room, Fronting on Highway So Public Can See Refinery in Operation

By D. P. THORNTON, Jr.
Southwestern Editor

THE $3,000,000 modernization program which Cosden Petroleum Corp. has just completed at its 18,000 b/d Big Spring, Texas, refinery had as its chief objective minimizing the production of heavy fuels and increasing the output of higher quality motor fuels.

The planning also included the installation of a new type, central control panel of the "graphic" type for the new Fluid catalytic cracking unit. The panel carries a flow diagram of the process. Controllers and indicators are located at the same points on the diagram as on the processing unit itself, and are pneumatically connected with valves and other control mechanisms installed on the unit.

Also, with an eye for good public relations, the control room is located adjacent to U. S. Highway 80, going east to Ft. Worth and west to El Paso. It is about 200 ft. back from the roadside. A picture window across the front of the building and special lighting have been arranged so that the interior is plainly visible from the highway. This has produced a high point of interest in the community. People passing on the road draw up their cars to watch a refinery operating.

The recently completed installations have been the culmination of the Cosden plant improvement program extending over many months. In 1946, the crude topping facilities were revamped, a Unisol plant for gasoline treating was added, the water and steam utilities and the vapor phase desulfurization equipment were improved.

Early this year the Cosden plant put into operation a new vacuum distillation tower to prepare feed for its thermal cracking unit, and eventually for the recently completed catalytic cracking unit, as well as to provide a means to manufacture high quality road and roofing asphalts. The program just completed called for the erection of a fluid "cat cracker", enlarging the gas concentration facilities and increasing the capacity of the polymerization unit, in which some existing equipment was revamped, as well as new equipment added. Throughout the operations, the crude capacity of the Big Spring refinery has remained unchanged.

The general refinery improvement program was based on a recognition by the Cosden Petroleum Corp. that its markets were changing and that even further changes were to be expected. For example, in common with many refineries, the market for No. 6 residual fuel had declined greatly, in part from the Dieselization of railroads serving this section of the country, while the market for middle distillates had expanded. Octane ratings required for motor gasoline were steadily trending upwards, although the company was having no difficulty in disposing of its thermally cracked material, and great volumes of motor gasoline were needed. A good market for high quality asphalt product was available.

The control room consists of the main panel and an auxiliary operator's desk containing a multipoint indicating pyrometer. The Panellit, Inc. panel is a "Panelgraph" or flowsheet section 12 ft. wide, with a wing on each side carrying recording instruments. On this flowsheet, shown in Fig. 1, is depicted the Fluid cracking and the gas concentration units. Controls and indicators for the various instruments and valves are located on this flowsheet.

This arrangement is described as very "natural" and easy for the operator to learn. To change the setting of a valve on the unit, the operator goes to that spot on the panel and alters the control until the de-

THIS MONTH'S COVER PICTURE

One of the outstanding features at the remodeled Big Springs refinery of Cosden Peroleum Corp. is its new ultra-modern control room. A huge picture window across the entire front of the building faces the main highway passing the plant, and gives motorists an unusual view of how a refinery is run. Dominant in the picture is the new central "graphic" control panel for the fluid unit. Flowers have been planted immediately inside the control room, behind the window, and a low decorative fence will separate the refinery grounds from the highway

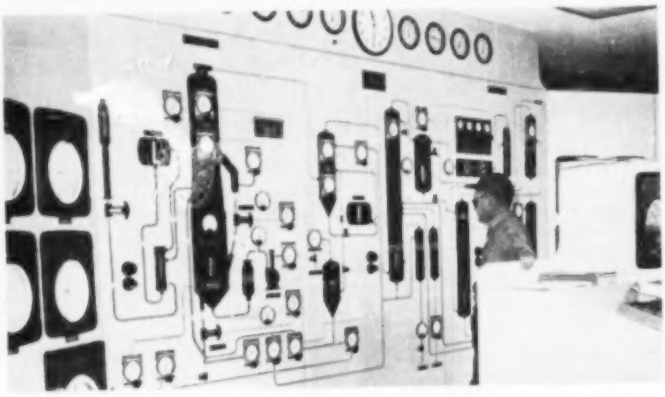


Fig. 1—Graphic type control panel for Cosden's Fluid and gas concentration units, with various recorders mounted on side wings

sired response is obtained.

The unit flowsheet carries anodized aluminum symbols and formed aluminum strips for piping in seven colors. Gold is for oil, yellow for vapors, orange for recycle streams, blue for air, green for water, red for catalyst and silver for instrument lines. The actual control instruments themselves were furnished by Foxboro with flows controlled by Fisher Governor Co. valves. The most important of the recording instruments are located to the right and left of the panel.

The development of the console, or graphic, type of control panel has been thought of for years, the principal advantages being sought were those of space saving, centralization of control facilities, reducing costs, simplifying personnel training and unit operation and, perhaps, the possibility of improving control. The Cosden panel is the second to be placed into operation, although several others now are under construction. A second feature of this development is the principle of locating controllers at the point of measurement, rather than on the control panel, with only the most important recorders being located in the control room.

There are two relatively new features involved in the instrumentation, aside from the graphic panel itself. Foxboro considers one of its main contributions to this installation is the use of their "D/P" (differential pressure) cell. This is a diaphragm flow transmitter employing the force-balance principle, wherein the cell is connected to the orifice flange measuring flow instead of the more conventional transmitter employing mercury. Seal and condensate pots are not required. The high and low pressure leads are connected to the diaphragm, which by its movement measures the differential created by the orifice and transmits this to a force bar which alters the flapper-nozzle arrangement transmitting air pressure to the receiving instrument. The corrosion resistant construction of the cell and diaphragm are said to greatly reduce difficulties normally encountered in measuring flow of corrosive fluids.

The second unusual instrument is the Foxboro multi-record "Dynalog" mounted on the main control panel. This instrument records six different temperatures on a 24-hour chart. The record gives the impression of being continuous and is easily read, although each point of the six traces actually is recorded 36 seconds apart. This electronic instrument measures a temperature every six seconds.

Because of the appearance of the graphic panel, the casual observer would be led—erroneously—to believe there was little in the way of the usual instrumentation in the plant. This is not true, for an inspection of the unit itself will reveal them. The function of supervision alone has been taken over by the graphic panel and only those essential records are made in the control room.

Remote supervision of flows, temperatures and pressures are obtained with Moore Products stations and Model 52 controllers. In effect, the station instrument, located on the graphic panel, indicates the reading of the particular control instrument involved by a dial and pointer just like a pressure gauge. At one side of the dial is a knob, by which the operator may alter the set point of the controller. At will he may switch from automatic to manual operation and ascertain stem position of the controlled motor valve.

The station itself actually is a pressure gauge, receiving its positioning from controlled air pressure sent out by the Moore transmitter in response to the Foxboro instrument detection signal as would the pointer or pens of the familiar indicating or recording instrument. The control knob, in turn, transmits a pneumatic signal back to the Moore controller. In effect this corresponds to the manual resetting of the control point on the usual instrument. The Moore controller, in turn, transmits this new setting to the locally-mounted Foxboro instrument which controls the actual process.

For a further description of the graphic panel, the reader is referred to PETROLEUM PROCESSING, Sept., 1949, p. 979, and Oct., 1949, p. 1097.

Fluid Unit Construction

The new Fluid cracking unit has a carbon burning capacity of 5000 lbs. of coke per hr., uses a conventional 5-stage Elliott turbo-blower of 1575 hp., rated to supply 15,500 cfm.of regeneration air at 25 psig. On the basis of 65% charge conversion, the unit will handle approximately 5500 b/d of fresh feed; on 50% conversion, 7000 b/d of feed. It was designed by the Refinery Engrg. Co. in the latest Universal Oil Products Co. "package" design, featuring the reactor located above the regenerator, and the structure combined into a single tower by a skirt.

Erection procedure was unique in that the reactor, regenerator, skirt, and auxiliary equipment were completely fabricated horizontally on the ground, and then erected in two sections to complete the unit.

As far as possible, the tower was prefabricated in the Los Angeles shops of Southwestern Engrg. Co., and then shipped in assemblies as large as railroad limits of 12-ft. diameters would permit.

At Big Spring, Southwestern assembled the unit on a ground-level, concrete slab. Internal bracing maintained accurate shape. Trunnion rollers permitted turning the two principal vessels for flat-position welding.

The finished tower was within one half-inch of specified height and less than 0.1875 in. out of plumb. Field work was completed in 117 days. Pacific Crane and Rigging, Inc., Los Angeles, provided the special hoisting equipment, which included two 150-ft. gin poles with connecting bridge, capable of handling up to 600 tons, and cooperated with Southwestern in the erection job.

Plant Operation

The refinery currently is charging approximately 3000 b/d of 44 API gravity sweet Vealmoor crude, trucked to the plant from Howard and Borden Counties, Texas, and 12,000 b/d total of Howard-Glasscock and East Howard sour crudes are

received by pipeline. The latter crude is asphaltic base.

Since the sweet and sour crude stocks are kept separate, the plant operates about one week out of four on the sweet material, and the other three weeks on the 29.7 gravity sour stock, which contains about 50 lbs. of salt per 1000 bbls. and averages 1.5% sulfur. All crudes are processed through a battery of six Petreco desalters, the effluent containing about 2 lbs. per 1000 bbls. of salt.

The block diagram of Fig. 2 shows the operation with sweet crude, the yields being predicated on 12,000 bbls. per stream day, representing current operations. This material is topped in a conventional crude unit, approximately 60% being taken overhead as straight-run gasoline, kerosine, and No. 2 distillate. The gasoline and kerosine are doctor sweetened and the No. 2 distillate caustic washed for compatibility with the light cycle oil.

The topped crude, 40% on charge, then is taken to the vacuum unit where 75% is taken overhead under a vacuum of 27 in. Hg and transfer temperature of about 740° F. Control on this column is dictated by the asphalt bottoms penetration desired (generally 90 penetration), or residuum composition when asphalt is not being made. The overhead material has an N.P.A. color between 4+ and 5 and a Conradson carbon below 0.5%. Vacuum is obtained with a 3-stage steam ejector. When sweet crude is charged, no asphalt is made, the vacuum bottoms being charged directly to Dubbs thermal cracking. The overhead material is catalytic cracking charge.

In sour crude operation, vacuum unit overhead also goes to catalytic cracking. The bottoms are penetration asphalt. The thermal cracker under this processing scheme also receives reduced crude from crude topping and may also charge both heavy and light catalytic cycle oil or only the reduced crude. A block diagram incorporating this processing scheme and the balance of plant operation is shown in Fig. 3.

Sour and sweet overhead streams from the vacuum unit are commingled as charge to the Fluid unit. The process flow is conventional, the unit being designed to process 6000 BPSD of 26.5 API mixed gas oil on a once-through operation at 50% conversion. Provision was made to recycle heavy gas oil if so desired, resulting in a higher conversion at a lower charge rate. At the present time 600 BPSD of fresh feed, 1900 BPSD of heavy recycle and 100 BPSD of slurry oil are being charged to the unit with a resultant conversion of the feed. Particulars of this operation are given in Table 1.

The cracked vapors are separated from entrained catalyst in the auxiliary column, the overhead from which is split in the main column into distillate, light and heavy cycle oil. Gas from the distillate receiver is picked up by a battery of four 286 Hp. Ingersoll-Rand V-8 compressors for discharge to the gas recovery

TABLE 1—Fluid Unit, Present Operation

	Operation A[11]	Operation B[12]
Catalyst Side		
Coke burn, lbs./hr.	4250[13]	4600[13]
Circulation, tons/min.	6.5	7.4
Catalyst:oil ratio	8.6	8.3
Space velocity, weight hourly on combined feed	7.5	8.9
Reactor temperature, °F	875	880
Reactor pressure, psig	10	10
Regenerator temperature, °F	1095	1115
Regenerator pressure, psig.	16	16
Oil Side		
Fresh feed, BPSD	5100	6000
Heavy recycle, BPSD	1500	1900
Slurry, BPSD	175	100
Combined feed ratio, total feed÷bbls. fresh feed	1.33	1.33
Conversion, %	63.0	63.0
Cracking efficiency, %	87.3[14]	87.3[14]
Clarified slurry oil	140	

Yields

	A B/D	A Vol.-%	B B/D	B Vol.-%
Gasoline	2800	55.0		55.0
Light cycle oil	1500		1800	
Heavy cycle oil	250	37.0	250	37.0
Clarified slurry oil	140		150	
Coke	227[15]	6.4		5.9
		wt.-%		wt.-%

(13) Including 10.5% hydrogen in catalyst coke.
(14) Including 13.0% hydrogen in coke.
(15) 10 lbs. RVP gasoline.
(16) Fuel oil equivalent.
(11) A. Operation with nominal 5000 b/d fresh feed.
(12) B. Operation with nominal 6000 b/d fresh feed.

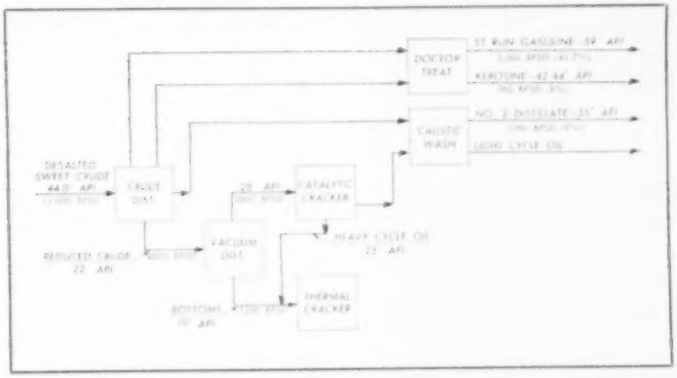


Fig. 2—Schematic diagram of plant operation and yields on sweet crude operation. Thermal and catalytic unit yields are omitted because these units charge both sweet and sour cuts commingled

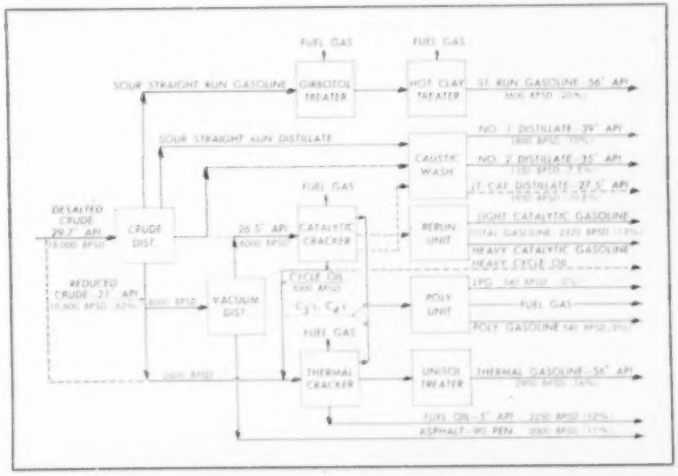
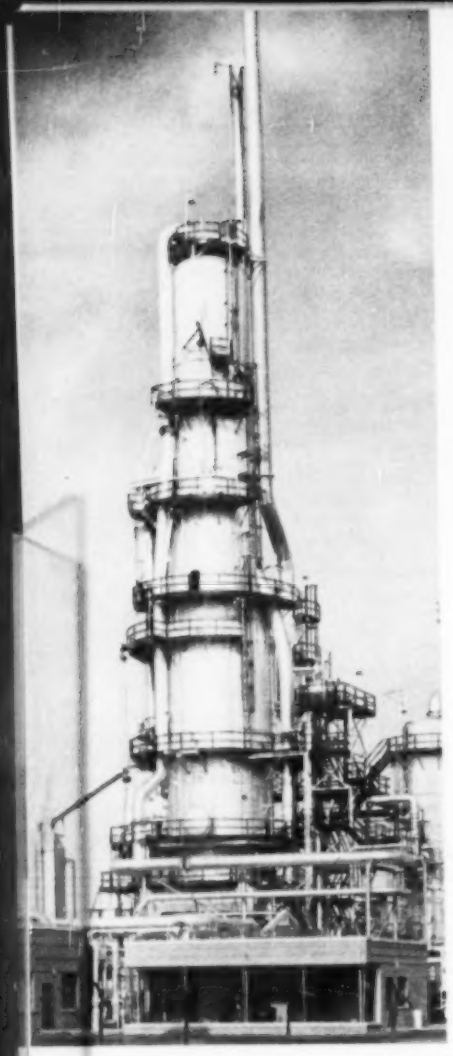


Fig. 3—Schematic diagram of plant operation and yields, operating on sour crudes



Cosden's new Fluid unit, with picture window control house in immediate foreground

unit at 200 psi. Here C_3's and C_4's are condensed and lighter components discharged to fuel gas. The mixed C_3-C_4 fraction from stablization of gasoline is charged to the gas polymerization unit.

The catalytic gasoline, having a 91 Research clear octane, is split into two fractions at the rerun unit, the light material having a 90% point at 300 to 305° F., and the heavy gasoline a boiling range of 340 to 425° F. Light catalytic distillate is withdrawn for fuel oil, while the heavy cycle oil is in part returned to the unit as noted previously and the balance thermally cracked.

Process pumps in the catalytic cracking and gas concentration units were supplied by Worthington and Ingersoll-Rand, with steam drivers by Elliott and electric drives by General Electric and Westinghouse. Southwestern Engineering furnished bulk of the new exchanger equipment; Braun the auxiliary column waste heat 150 psi. steam generator. The main fractionator and auxiliary column were part of the old No. 1 Dubbs cracking unit and are on their original foundations; the internals were revamped. The old Dubbs pump house and box condensers atop it were re-used; the cooling tower is a conventional Fluor 3-cell 600 gpm. 15° approach unit.

Mixed C_3-C_4 from both the thermal and catalytic cracking units are commingled and charged to polymerization. This unit utilizes the U.O.P. chamber type process, with phosphoric acid catalyst. It has a reactor pressure of 500 psi. and conversion temperature of 400° F. (360° F. entry and 420° F. outlet). The charge capacity is 3017 bbls. per stream day of combined feed having a 30% olefin content, the components being 1450 BPSD of fresh feed with a higher olefin content of 53.2% and 1567 BPSD of recycle feed containing 9.8% higher olefins.

The fresh feed is first de-ethanized, followed by a regenerative caustic and water wash. Almost all of the hydrogen sulfide is lost overhead with the ethane and lighter, while the caustic and water wash take care of the final clean-up. The water wash also supplies the necessary moisture to maintain catalyst hydration. The product is depropanized and then stablized to a 10-lb. vapor pressure. Depropanizer overhead is yielded as LP-Gas and is also used to quench the polymerization reaction for temperature control. Higher olefin conversion is 90%. A new reactor, 40 ft. high by 5 ft. diameter, was added to provide the necessary additional capacity during the latest plant modernization.

Quality of Products

The plant now is equipped to produce, in addition to gasoline, 42-44 gravity w.w. kerosine, Nos. 1 and 2 fuels, a 100% virgin Diesel oil of 50 cetane number minimum, all grades of roofing and road asphalts, asphalt emulsions, liquefied propane and butane, and No. 6 fuel oil. Four grades of gasoline are produced: a 10-lb. poly gasoline of 95 Research octane rating, housebrand and premium grades, and a "special" premium which reportedly has the highest octane rating of any finished motor fuel produced in the Southwest. Specifications for these products are given in Table 2.

The modernization program called for slightly more than $3,000,000 in capital investment. Of this amount, approximately $2,150,000 was for erection of the Fluid and gas concentration units, site clearance and the like; $40,000 for extra steam generating facilities installed in the plant; $150,000 for repairs to existing equipment, worth $300,000 before repairs started; $80,000 for new tankage; $60,000 for additional water cooling facilities; and $300,000 for the new feed preparation (vacuum) unit.

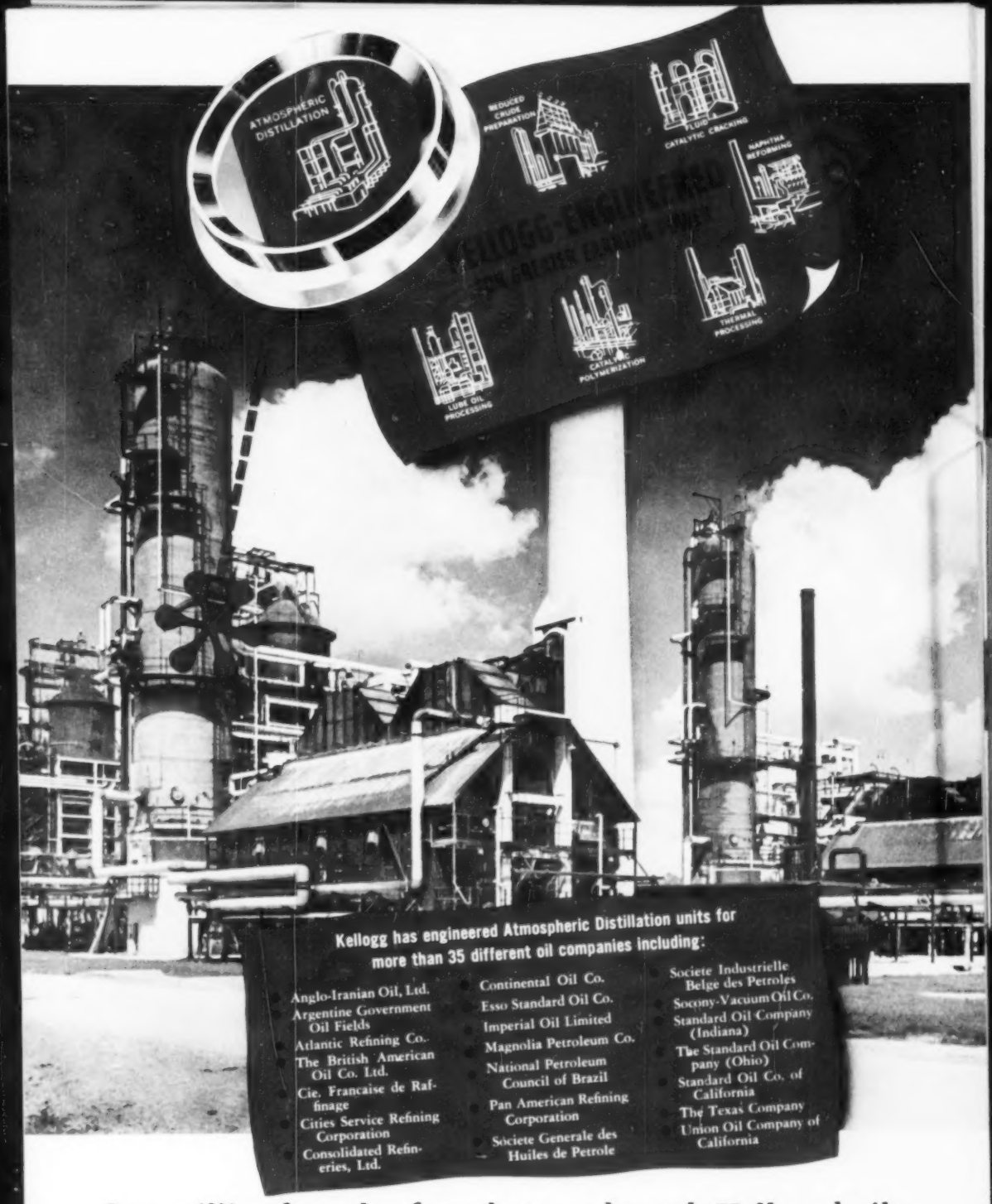
In comparing costs of producing gasoline by thermal vs. catalytic cracking, considering amortization of investment over a 15-year period, maintenance and direct operating costs, R. L. Tollett, Cosden president, places his thermal gasoline cost at about 30c per bbl. against 70c for the catalytic product. These figures do not consider the value of charging stock and apply only to the Big Spring installation.

The writer is indebted to the personnel at the Cosden Petroleum Corp. for much of the operating data presented in this article and to the Refinery Engineering Co., Tulsa, designers and contractors of the fluid and gas concentration units for design and process flow information. For a description of the Big Spring refinery as it was operated in 1946, the reader is referred to the *National Petroleum News* Technical Section, Aug. 7, 1946, pgs. R570-76.

TABLE 2—Gasoline Product Specifications

	Polymer Gasoline	House-brand	Premium	"Special" Premium
ASTM Distillation:				
IBP	85-95	95-105	95-105	———
10%	140-150	145-155	145-155	———
50%	210-220	245-255	245-255	———
90%	340-360	350-360	350-360	———
End Point	400-420	425	425	———
Recover, %	95	98	98	———
Min. % over at:				
140° F.	———	———	———	11
158° F.	———	———	———	15
212° F.	———	———	———	54-64
302° F.	———	———	———	90
Octane, Min. Research with 3 cc. TEL	95(2)	84	88	93.5(2)
Doctor	Pass	Pass	Pass	Pass
Corrosion	Pass	Pass	Pass	Pass
ASTM Gum, mg.	7	4	4	4
Copper Dish Gum, mg.	50	20	20	10
Sulfur, Max., %	0.20	0.20	0.20	0.10
Vapor Pressure, Reid, lbs.	10	11(3)	11(3)	11(3)
Induction period, min., hours	———	4	4	4

(1) Research octane, clear.
(2) Maximum of 2 cc. TEL.
(3) Winter grade.



Kellogg has engineered Atmospheric Distillation units for more than 35 different oil companies including:

- Anglo-Iranian Oil, Ltd.
- Argentine Government Oil Fields
- Atlantic Refining Co.
- The British American Oil Co. Ltd.
- Cie. Francaise de Raffinage
- Cities Service Refining Corporation
- Consolidated Refineries, Ltd.
- Continental Oil Co.
- Esso Standard Oil Co.
- Imperial Oil Limited
- Magnolia Petroleum Co.
- National Petroleum Council of Brazil
- Pan American Refining Corporation
- Societe Generale des Huiles de Petrole
- Societe Industrielle Belge des Petroles
- Socony-Vacuum Oil Co.
- Standard Oil Company (Indiana)
- The Standard Oil Company (Ohio)
- Standard Oil Co. of California
- The Texas Company
- Union Oil Company of California

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The applications have ranged from virtual skimming in Palestine where more than half of the crude was returned to ground reservoirs to the accurate fractionation of Pennsylvania crude.

They've been designed as independent units and in combination with decarbonizing, coking, cracking, vacuum distillation, visbreaking and reforming. Individual capacities have ranged from 1,000 to over 40,000 BPD.

In a phase of oil processing such as this, where building contracts are customarily open to practically any bidder, there must be definite reasons for *the record concentration in one company's hands* of contracts for more than a million barrels of capacity.

Kellogg invites refiners, who are modernizing old facilities or increasing crude capacity, to examine with its engineers the reasons for this preference.

FURNACE DESIGN AND TOWER "FLUIDYNAMICS" DETERMINE EFFICIENCY

Atmospheric Distillation is in essence a simple process—comprising only two unit operations—yet there are many pitfalls that can markedly affect stream efficiency. One would think that, with a process more than twenty-five years old, all important factors would have been discovered and formulated. But such is not the case with either furnaces or bubble towers. There is still much to be learned and new data are being obtained every day. That is why, over this entire period, Kellogg has never ceased to gather and evaluate operating data from all over the world, and has carried on continual research on both items of equipment.

Along these lines, the Lucite bubble tower (shown here) continues to operate in the Kellogg Engineering Laboratories, permitting engineers to carry on investigation of the problems of "Fluidynamics"—cap spacing, types of trays, dumping, entrainment and a host of other details.

IT TAKES ALL SEVEN! TO PRODUCE GREATER EARNING POWER...

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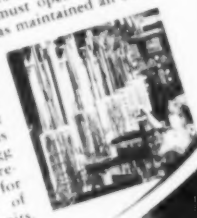
both equipment and people—to improve processing and equipment ideas. Most refiners know of Kellogg's extensive pilot plant and chemical laboratories—know the professional reputations of the men who guide their activities. But processes are only as good as the equipment within which they must operate. That is why, over the years, Kellogg has maintained an extensive Metallurgical Research and Development operation. Materials, fabrication methods and new types of equipment are its permanent projects. The contributions of this group to the Kellogg organization have been responsible in a major way for the superior efficiency of Kellogg refinery units.



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Plant Practices

Practical Tips and Ideas for Improving Operations

Revised Shaft Key Design Saves Time On Carbondale Wax Chiller Repairs

THERE'S an old saying about when an irresistible force meets an immovable object, and so on.

Maintenance men at Tide Water Associated Oil Co.'s Bayonne, New Jersey, refinery met that kind of situation not so long ago and decided that as long as they were going to have to fix a certain piece of equipment every now and then anyway, it might as well be arranged so the repair job was relatively fast and simple.

On the company's Carbondale wax chillers, the scraper shaft extends through a stuffing box in the exchangers out to the drive coupling, by which it is connected to the drive shaft, sprocket, etc., as shown in the upper sketch in Fig. 1. Due to the heavy torque, the keyway at the end of the scraper shaft would tear out occasionally.

To make a repair it was necessary to pull all 40 ft. of scraper shaft out of the exchanger to renew the stub end with one having a new key way. Since keyway failures seemed inevitable, the solution was to make sure they occurred on the short, external drive shaft rather than on the long, cumbersome scraper shaft.

This is shown in the lower sketch in Fig. 1. The coupling is keyed to both shafts with one continuous key, and to the scraper shaft with one short key. Thus, in case of failure the single key on the drive shaft should be the one to let go first.

In practice, it has worked out that way all the time. The photograph shows the drive shaft with its sprocket and a coupling in place. The double keys for attaching to the scraper shaft can be seen at the end.

Man-hours on Pipe Welding Cut 50% By Use of Simple, Shop-built Clamp

LINING up and welding together two sections of pipe now takes about half the time it used to in the Bayway refinery of Esso Standard Oil Co., as a result of a clamp devised by the maintenance department.

As illustrated in the accompanying photograph, the clamp is a split-ring arrangement, hinged at one point and with the opening diametrically opposite the hinge. The clamp is placed over the butt ends of the pipe sections to be welded after they have been aligned and leveled. It is then drawn up tight by means of a wedge driven into the slot, or loop, at the "buckling" end of the clamp.

A wide opening around most of the circumference of the clamp permits the workman to place a few tack welds on the joint. The clamp is then removed and a conventional bead put on to finish the job. Clamps are made in several sizes, the size

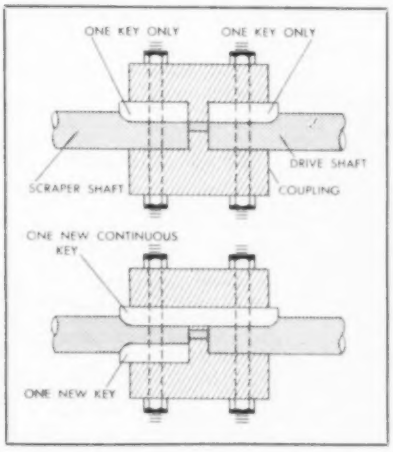
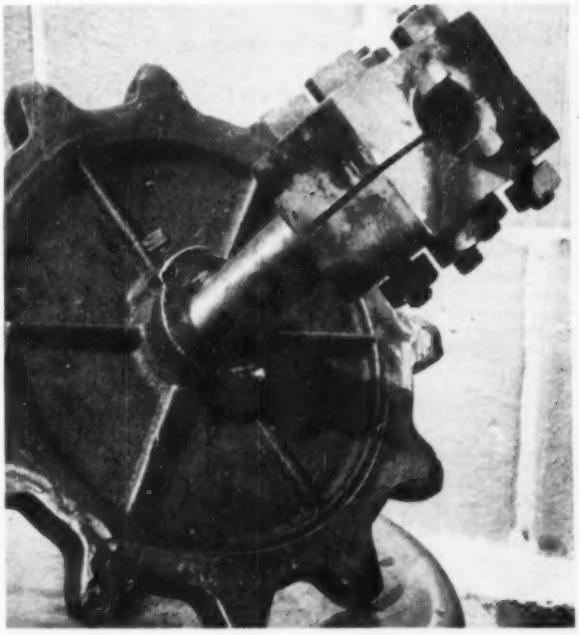
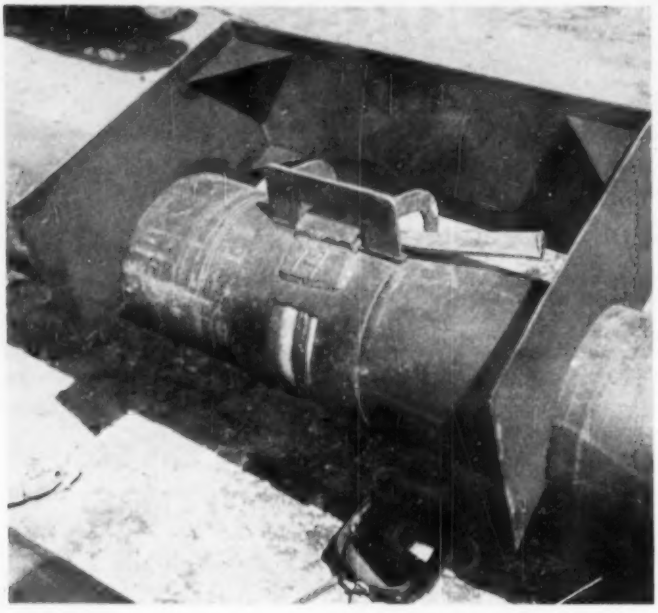


Fig. 1—Above: original key design on Carbondale wax chiller shaft. Below: revised key design which makes certain failure will occur on short, external drive shaft



Photograph shows the double key which is secured to the scraper shaft



Esso's clamp for facilitating lining up and welding pipe shown in place with a shop-made welding shield surrounding work area

number being placed on the clamp itself with a bead of weld metal: for example, 14-in. in the clamp shown.

Also to be seen in the picture is a simple welder's shield to protect the assistant from the glare of the arc. The shield is essentially a three-sided open box of heavy sheet metal, with strengthening gussets on the two inside corners and half-circles cut out of the two ends so it will fit over the pipe being welded.

Prefabricated Sleeves Stop Pipe Leaks

A HOME-MADE substitute for the so-called Dresser coupling is being used successfully at the Perth Amboy, New Jersey, refinery of California Refining Co. when a leak develops in a run of plant piping which must be repaired immediately without welding because the line is in service.

It consists of a simple sleeve made from a short length of pipe one size larger than that in which the leak has occurred. The sleeve pipe is cut into two equal halves and each has a length of angle iron welded alon, each edge so as to form flanges, as shown in Fig. 2.

This sleeve is placed over the smaller pipe and the annular space filled with oakum. The two halves are then bolted together with sheet gasket between the flanges. In the case of a leak in a water line, rubber gaskets can be used. The open ends are then filled with lead, and the job is done.

Repairs made in this way will hold almost indefinitely, and at least long enough until a new pipe can be installed. A stock of prefabricated repair sleeves of different sizes are kept on hand for the various piping in the plant so as to save time in the event of an emergency.

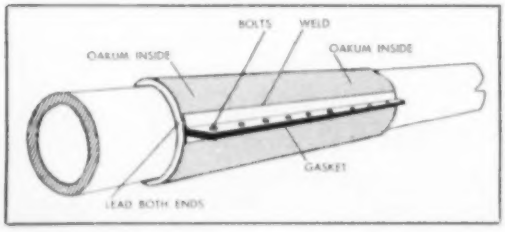


Fig. 2—Substitute for Dresser coupling serves as temporary pipe repair until welding can be done

Worn Agitators Replaced In 2 Hours Instead of 8

BY standardizing the mounting arrangements for side-entering agitators on fifteeen gasoline-blending tanks at the Latonia, Ky., refinery, the Sohio Petroleum Co. maintenance department has been able to cut the time for replacing a worn agitator from about 8 to about 2 hrs.

The side plates on the various tanks are of different sizes, and prior to the standardization program the holes in the plates did not follow any regular pattern or arrangement. Consequently, each time an agitator was pulled, it meant drilling new holes and plugging the old ones so as to accommodate the replacement agitator. The standardization involved drilling all tank side plates and all agitator mounting flanges to a common template.

The agitators themselves are all shop built. Belt-driven, they consist of a propeller mounted on the end of a heavy shaft, in turn journaled in a plain sleeve bearing. Sohio engineers found this type bearing to give rapid wear and frequent leakage because of the tendency to develop unevenness and wobble. As a satisfactory remedy, the shafts now are mounted in Link-Belt self-aligning roller bearings. They have shown no wear, in some cases, for as long as two years.

IDEAS—Wanted!

Plant superintendents, foremen, engineers!—Send in your own ideas on "How we do it around our refinery." Possible subject matter includes gadgets, tools, shortcuts in operations, time and money-saving paper work, safety and fire protection. Please include photographs, drawings, charts, etc., where available.

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American Republics Corporation depends on ALCOA Activated* Alumina to dry residue gas at their Silsbee, Texas, gasoline plant.

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Patent Trends in Petroleum Refining

By Peter J. Gaylor, Editor "The Technical Survey"

Rapid Cooling Improves Aluminum Stearate Greases

AMONG recent grease developments is one dealing with aluminum stearate greases, covered in U. S. 2,480,647 to Standard Oil Development Co. It has been found that when such greases are poured into 400 lb. drums, the portion next to the outside of the drums, which cools quickly, has a good consistency, while that in the center tends to be semi-fluid and grainy in appearance.

When aluminum stearate is mixed in mineral oil in grease-forming proportions and the mixture is heated to a temperature of 275°-350° F., a rubbery plastic mass is formed. When the resulting grease is cooled, the rubbery mass changes to a gel or regular grease structure at around 100°-130° F., this being known as the transition temperature, which varies somewhat, depending on the proportions of constituents used. Further cooling beyond the transition range, with agitation, tends to break down the gel to a stringy semi-liquid product having grainy characteristics. However, if agitation is stopped just a few degrees below the transition temperature, a firm gel of desirable consistency and texture is obtained.

The patent specifies the use of solid carbon dioxide as a refrigerant to lower the grease temperature rapidly below the transition temperature. The recommended procedure involves combining 5-15 parts by weight of aluminum stearate, 0.5-2.5 parts of a phenol modifier, and 94.5-82.5 parts of a mineral lubricating oil, heating the composition to 275°-350° F. to form a grease, cooling the grease rapidly by means of external water, accompanied by mechanical working, to a temperature approaching the transition temperature, and thereafter mixing 0.5-3 parts of solid carbon dioxide to the grease to reduce its temperature rapidly towards the end of the cooling operation.

High Speed Quenching Oils From Aromatic Hydrocarbons

THE disadvantage of ordinary mineral oils as metal quenching media is that they do not offer the desirable high initial quenching rates that are characteristic of aqueous baths. This disadvantage is particularly important in the production of certain steels having high critical cooling rates.

In its U. S. Patent 2,485,103, Socony-Vacuum Oil Co. discusses a discovery that alkyl-substituted polynuclear aromatic hydrocarbons have all of the advantages of ordinary mineral oils as quenching media and exhibit initial quenching speeds far surpassing those of ordinary mineral oils.

A preferred quenching fluid is a cut (Aromatic Oil "A") prepared from a cycle stock from a multipass catalytic conversion process which has the approximate properties outlined below:

Gravity, °API	3.6
Flash point, Cleveland open cup, °F.	335
Pour Point, °F.	<0
Viscosity, SSU:	
@ 100° F.	130
@ 210° F.	37
Boiling range, °F.	575-750
Refractive index @ 60° F.	1.62

The effect of small concentrations of such alkyl substituted polynuclear aromatic hydrocarbons on the quenching speed of a conventional Mid-Continent paraffin base mineral oil having a boiling range of 450°-800° F., viscosity of 100 SSU at 100° F., and Cleveland open cup flash point of 320° F. is demonstrated by the following results:

Amount of Aromatic Oil "A" in blend, %	Initial 5-second Quenching Speed, %
0	14.3
1.0	23.0
2.5	21.8
5.0	20.6
10.0	21.7
25.0	21.7
85.0	27.6

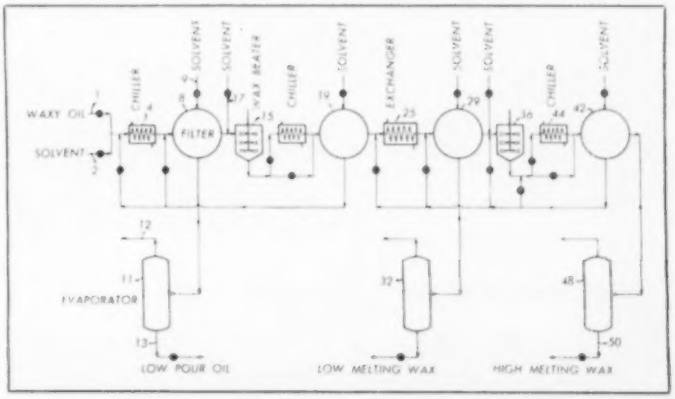
It will be noted that the addition of the first few percentages of aromatic oil "A" promoted the quenching speed of the Mid-Continent oil far in excess of what would be expected for the small proportion of aromatic oil "A" added.

Improved Dewaxing Process Uses Less Equipment, Solvent

IN a recent patent, U. S. 2,486,014, Atlantic Refining Co. describes a rotary drum dewaxing process in which less equipment and solvent are said to be required when compared to conventional processes. The unit produces a low pour point oil, a high melting wax of low oil content, and a low melting wax.

As can be seen from the flow sheet below, waxy oil from line 1 and solvent (e.g. 40% methyl ethyl ketone, 45% benzene and 15% toluene) from line 2 are fed into mixer-chiller 4 where both low and high temperature waxes are crystallized out, these being separated by rotary drum filter 8 (with solvent spray from line 9), and low pour oil is removed as bottoms 13 from evaporator 11, which removes solvent through line 12.

After addition of more solvent through line 17, the wax is fed into beater 15 and then to drum filter 19 from which some more oil is removed. Thereafter, the wax is passed through heat exchanger 25 wherein the temperature of the mass is raised sufficiently to dissolve the low melting wax but not the high melting wax. Filtrate from drum filter 29 is separately treated in evaporator 32 to recover low melting wax as bottoms. Then, in another succession of wax beater 36, chiller 44 and drum filter 42, the wax cake from filter 42 is fed into still 48 and high melting wax is recovered at bottoms 50.



Flow chart of Atlantic Refining Co.'s rotary drum dewaxing process, which is said to require less equipment and solvent than conventional processes. (U. S. 2,486,014)

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Principles of Reactor Design

These two valuable series of articles which originally appeared in *Petroleum Processing* and its predecessor, the *Technical Section of National Petroleum News*, are again available. Out of print for some time, they have now been republished as a result of continued inquiries from readers.

PROCESS ENGINEERING DATA: Seven articles dealing with improved methods for correlating and predicting fundamental data required in the design of modern petroleum and chemical processing plants. Based on research work in Chemical Engineering at the University of Wisconsin. Dr. K. M. Watson, well-known authority in petroleum refining technology, is supervising author. First published in 1946. (39 pages, 8 x 11 in., illustrated) $1.50*

PRINCIPLES OF REACTOR DESIGN: Four articles prepared by Dr. K. M. Watson and his associates at the University of Wisconsin, on the basic principles for the design, engineering and operation of reactor equipment for some of the modern refining processes. First published in 1944. (48 pages, 8¼ x 11¼ in., illustrated) ..$1.00*

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Patents Issued in November

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for Nov. 1, 8, 15, 22 and 29, Vol. 628, Nos. 1-5.

Fuels

2,486,538 (Universal Oil Products Co.)—Metal deactivator for gasoline.
2,487,103 (Standard Oil Development Co.)—Fuel oils from acid sludge.
2,487,189-90 (Gulf Oil Corp.)—Doped diesel fuel oils.
2,487,752-4 (Baker & Co.)—Igniting organic fuels.
2,487,797 (Friedman et al)—Detecting water in fuels.
2,487,909 (Standard Oil Development Co.)—Synthesis catalyst purification.
2,489,051 (American Cyanamid Co.)—Rocket propulsion utilizing hydrocarbon, sulfate, turpentine, nitric acid and sulfuric acid or oleum.
2,489,514 (Phillips Petroleum Co.) — Storing and vaporizing liquefied gases.

Conversions

2,486,627 (Phillips Petroleum Co.)—Hydrocarbon conversion employing pebble passageways.
2,487,065 (Houdry Process Corp.)—Gel catalysts.
2,487,132 (Standard Oil Development Co.) — Contacting gaseous fluid with solid particles.
2,487,324 (Phillips Petroleum Co.)—Combination cracking process.
2,487,743 (Phillips Petroleum Co.)—Fixed bed catalytic conversion.
2,487,794-6 (Socony-Vacuum Oil Co.)—Hydrocarbon conversion with powdered catalyst.
2,487,824 (Houdry Process Corp.)—Catalytic conversion with pretreated and activated clays.
2,487,961 (Universal Oil Products Co.)—Catalytic conversion of fluid reactants.
2,487,978 (Universal Oil Products Co.)—Isomerizing cracked gasoline with alumina and halide.
2,488,027-033 (Standard Oil Co.—Indiana)—Catalytic conversion with powdered catalyst, using catastat.
2,488,488 (Socony-Vacuum Oil Co.)—Conversion of fluid hydrocarbons with powdered catalyst.
2,488,493 (Socony-Vacuum Oil Co.)—Conducting gas-solid contact operations.
2,488,602 (The Texas Co.)—C_5 alkylation with aluminum chloride-hydrocarbon complex catalyst.
2,488,603 (The Texas Co.)—Propylene alkylation with similar catalyst.
2,488,712 (Universal Oil Products Co.)—Catalytic cracking of residual hydrocarbons.
2,488,736 (Standard Oil Development Co.) — Polymerization of olefins with Friedel-Crafts catalysts dissolved in water containing alkyl halide solvents.
2,488,752 (Universal Oil Products Co.)—Conversion of olefins to higher molecular weight, using reaction product of oxygen, boron trifluoride and hydrocarbon as catalyst.
2,488,942 (Anglo-Iranian Oil Co.)—Maintaining acid catalyst concentration in alkylation.
2,489,628 (Socony-Vacuum Oil Co.)—Cracking process for producing olefins from hydrocarbons.

Refining

2,486,519 (Universal Oil Products Co.)—Desulfurizing hydrocarbons with fluosulfonic acid.
2,486,778 (Union Oil Co.)—Separating acid gas from gaseous mixture.
2,487,142 (Phillips Petroleum Co.)—Removing HF selectively from propane.
2,487,147 (Phillips Petroleum Co.)—Fractionating methane and ethane from mixtures.
2,487,306 (Phillips Petroleum Co.)—HF treating lube oils.
2,487,466 (Union Oil Co.)—Catalytic desulfurization of hydrocarbons with cobalt on alumina-bauxite.
2,487,576-8 (Phillips Petroleum Co.)—Removal of acidic material from gaseous mixture.
2,487,804-5 (Socony-Vacuum Oil Co.)—Separating hydrocarbons by selective sorption process.
2,487,806 (Socony-Vacuum Oil Co.) — Deasphalting.
2,488,145 (Standard Oil Development Co.)—Hydrogenation of liquid olefin polymers.
2,488,593 (Standard Oil Development Co.)—Resolving petroleum emulsions.
2,488,855 (Trenton)—Sweetening distillates with clay, hypochlorite and caustic.
2,489,949 (Socony-Vacuum Oil Co.)—Controlling fractionating column.

Chemicals

2,486,373 (L. Sonneborn Sons, Inc.)—Heat stabilization of petroleum mahogany sulfonates.
2,486,441 (Socony-Vacuum Oil Co.)—Condensation of olefins with organic compounds.
2,486,454-6 (Tide Water Associated Oil Co.)—Polybasic acids by oxidation of paraffins.
2,486,543 (Universal Oil Products Co.)—Separating ethylene from gases.
2,486,648 (Shell Development Co.)—Diamines.
2,486,693 (Shell Development Co.)—Alcohols from carbon monoxide and hydrogen.
2,486,831 (Socony-Vacuum Oil Co.) — Homopolymerization of benzyl compounds.
2,486,842 (Shell Development Co.)—Catalytic oxidation of hydrocarbons.
2,486,923-4 (Phillips Petroleum Co.)—Acid-resistant polymers.
2,486,929 (Phillips Petroleum Co.)—Azeotropic distillation of methyl acetylene from butadiene.
2,486,980 (Phillips Petroleum Co.)—Catalytic vapor phase hydration of ethylene.
2,487,086 (Standard Oil Development Co.)—Separating isopropanol from sec. butanol by azeotropic distillation.
2,487,124 (Standard Oil Development Co.)—Extraction of ketones.
2,487,184 (Standard Oil Development Co.)—Butadiene purification.
2,487,278 (Standard Oil Development Co.) — Rubbery isoolefin copolymer of improved cold resistance.
2,487-280-90 (Socony-Vacuum Oil Co.)—Separation of nitriles.
2,487,338 (Socony-Vacuum Oil Co.)—Condensing aromatic hydrocarbons with terpenes.
2,487,986 (Universal Oil Products Co.)—Reaction of bicyclo-olefins with alkyl halides.
2,488,000 (Pure Oil Co.)—Oxidizing mercaptans with oxygen in presence of metal alcoholate containing some phenol.
2,488,083 (Socony-Vacuum Oil Co.)—Converting methyl chloride into liquid hydrocarbons.
2,488-112 (Standard Oil Development Co.) — Curing isobutylene-isoprene copolymers.
2,488,149 (Standard Oil Development Co.)—Emulsion polymerization using ethanolamine soap.
2,488,479 (Pure Oil Co.)—Phenols from thiophenols.
2,488,550 (Shell Development Co.)—Salts of unsaturated acid-branched chain hexadiene polymer adducts.
2,488,721 (Standard Oil Development Co.) — Mahogany sulfonic acids.
2,489,042 (American Cyanamid Co.)—Recovery of naphthalene from petroleum products.
2,489,122 & 51 (Socony-Vacuum Oil Co.) — Dinitroparaffins.
2,489,316 (Standard Oil Co.—Indiana)—Sulfonic anhydrides.
2,489,317 (Standard Oil Co.—Indiana)—Sulfonyl halides.
2,489,318 (Standard Oil Co.—Indiana)—Alkane sulfonic acids.
2,489,320 (Socony-Vacuum Oil Co.)—Nitration of paraffins.
2,489,346-7 (Standard Oil Development Co.)—Phthalic anhydride, etc. by oxidation.
2,489,619 (Standard Oil Development Co.) — Propyl alcohol.
2,489,672 (Tide Water Associated Oil Co.) — Dialiphatic aminoalkylcarbazol.
2,489,674 (Socony-Vacuum Oil Co.) — Vinyl resin plasticizers.
2,489,729 (Shell Development Co.)—Cyano-substituted tetrahydropyran compounds.

Lubricants

2,486,493 (Tide Water Associated Oil Co.) — Mineral oil containing polymerized ester of acrylic acid and oil soluble ester of phosphorus acid.
2,487,080-1 (Standard Oil Co.—Indiana)—High temperature greases containing sulfonates.
2,487,151 (Standard Oil Development Co.) — Pour inhibited oil.
2,487,260 (Standard Oil Development Co.) — Extreme pressure lubricant.

Patent Trends

2,487,261 (Standard Oil Development Co.) — Low temperature grease containing alkyl silicon and acetylene black.
2,486,376-9 (Socony-Vacuum Oil Co.)—Greases containing resins or gums.
2,488,124 (Standard Oil Development Co.) — Sulfur-aromatic barium salt.
2,488,293 (Lion Oil Co.)—Heavy duty industrial grease containing air blow asphaltic product.
2,488,449 (Gulf Research & Development Co.)— — Organo-silicon - phosphorus condensation products.
2,488,618 (Standard Oil Development Co.) — Lubricants of the extreme pressure type.
2,488,662 (California Research Corp.) — Zinc organo phosphates.
2,489,281 & 300-1 (California Research Corp.) —Methacrylates, etc. in constant viscosity oil.
2,489,671 (Tide Water Associated Oil Co.)— Additive-containing lube oil.

Hydrocarbon Synthesis

2,486,505 (Texaco Development Corp.) — Hydrocarbon synthesis.
2,486,633 (Phillips Petroleum Co.)—Hydrocarbon synthesis with alcohol cycle.
2,486,879 (Texaco Development Corp.)—Hydrocarbon synthesis.
2,486,894-5 (The Texas Co.)—Catalytic hydrogenation of carbon monoxide.
2,487,159 (Standard Oil Development Co.)— Regenerating iron type synthesis catalyst.
2,487,867 (Standard Oil Development Co.) — Synthesis catalyst purification.
2,488,150 (Standard Oil Development Co.) — Preparation and regeneration of a hydrocarbon synthesis catalyst (fluidized).
2,488,406 (Gulf Research & Development Co.) —Conducting synthesis reactions.
2,489,309 & 32 (Houdry Process Corp.)—Iron-freed acid-treated kaolin catalyst.
2,489,451 (Standard Oil Development Co.) — Hydrocarbon synthesis.
2,486,533 (Universal Oil Products Co.)—Producing selective olefinic polymers, e.g. propylene tetramer.
2,486,688 (Shell Development Co.)—Deodorizing benzene hexachloride.
Re. 23,168 (Gulf Oil Corp.)—Stabilized pyrethrin insecticide.
2,489,176 (Stancal Asphalt & Bitumels Co.)— Adhesive composition for paper.

Catalysts

2,486,484-5 (Phillips Petroleum Co.)—Treating metal halide sludge.
2,487,717 (California Research Corp.)—Controlling catalyst regeneration.
2,488,128 (Standard Oil Development Co.) — Silica microsphere supported iron group catalyst.
2,488,530 (Phillips Petroleum Co.)—Feldspar-iron-alkali Fischer-Tropsch catalyst.
2,488,718 (Standard Oil Development Co.) — Removal of catalyst impurities from regenerated catalyst.
2,488,744 (Standard Oil Development Co.) — Regeneration of cracking catalysts.
2,489,333 (Houdry Process Corp.)—Catalyst composite of silica-alumina gel on acid-treated clay.
2,489,334 (Houdry Process Corp.)—Siliceous plural gel catalysts containing refractory metal oxide.
2,489,863 (Lummus Co.)—Regenerating moving bed catalyst material.
2,489,925 (Lummus Co.)—Catalyst feeder.

Miscellaneous

2,486,550 (Phillips Petroleum Co.) — Adding solids to liquids under pressure.
2,486,845 (The Texas Co.)—Measurement of wall thickness.
2,487,104 (Standard Oil Development Co.)— Pressure vessel safety device.
2,488,558-9 (Shell Development Co.)—Purification of penicillin.
2,489,136 (A-B. Aerotransport)—Viscosity Regulator.

How to Obtain Patents

Readers may obtain copies of U. S. patents from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

Loading racks are safer... take more abuse longer... when built with CHIKSAN Ball-Bearing Swivel Joints.

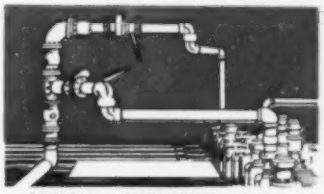
For greater safety and longer life, use CHIKSAN Ball-Bearing Swivel Joints in loading and unloading lines handling most types of chemical compounds.

Eliminate fire and explosion hazards in lines handling Liquefied Petroleum Gases by using CHIKSAN Ball-Bearing Swivel Joints and all-steel lines.

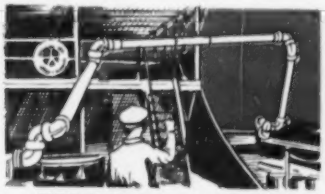
It's safer...and less expensive ...to insure safety *all* the way in your loading and unloading lines. With CHIKSAN *Ball-Bearing* Swivel Joints, you get the same strength...the same safety ...the same protection throughout your entire piping system because you can build your own flexible loading and unloading lines with pipe and fittings of the same strength and long life as you design and build into all other parts of your piping system. You eliminate all weak links! You eliminate all the variable hazards which increase with age and usage in all types of fabric or flexible metal hose.

Play safe *all the way!* Use CHIKSAN *Ball-Bearing* Swivel Joints to make up your loading and unloading lines. With them, you get unlimited flexibility with the strength, long life and safety of steel. You get greater protection...greater safety ...and greater economy with CHIKSAN.

CHIKSAN's Engineering Department will gladly assist you in designing flexible lines to suit your individual needs. This Service is based on 25 years of experience in designing and developing Ball-Bearing Swivel Joints for every purpose.



Transfer lines using CHIKSAN *Ball-Bearing* Swivel Joints save cost of extra valves and fittings... eliminate contamination losses.



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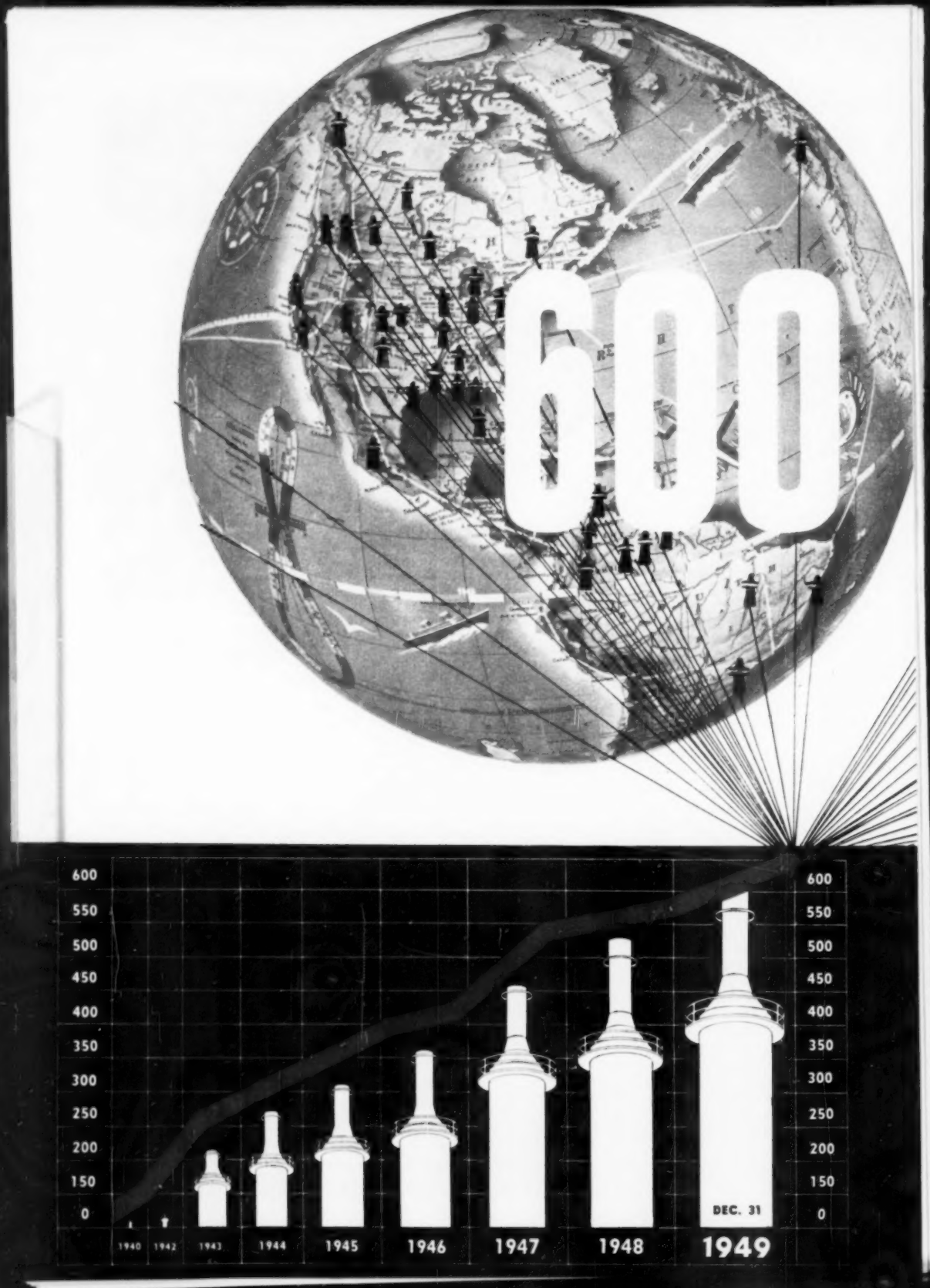
[To obtain more data on advertised products see page 80]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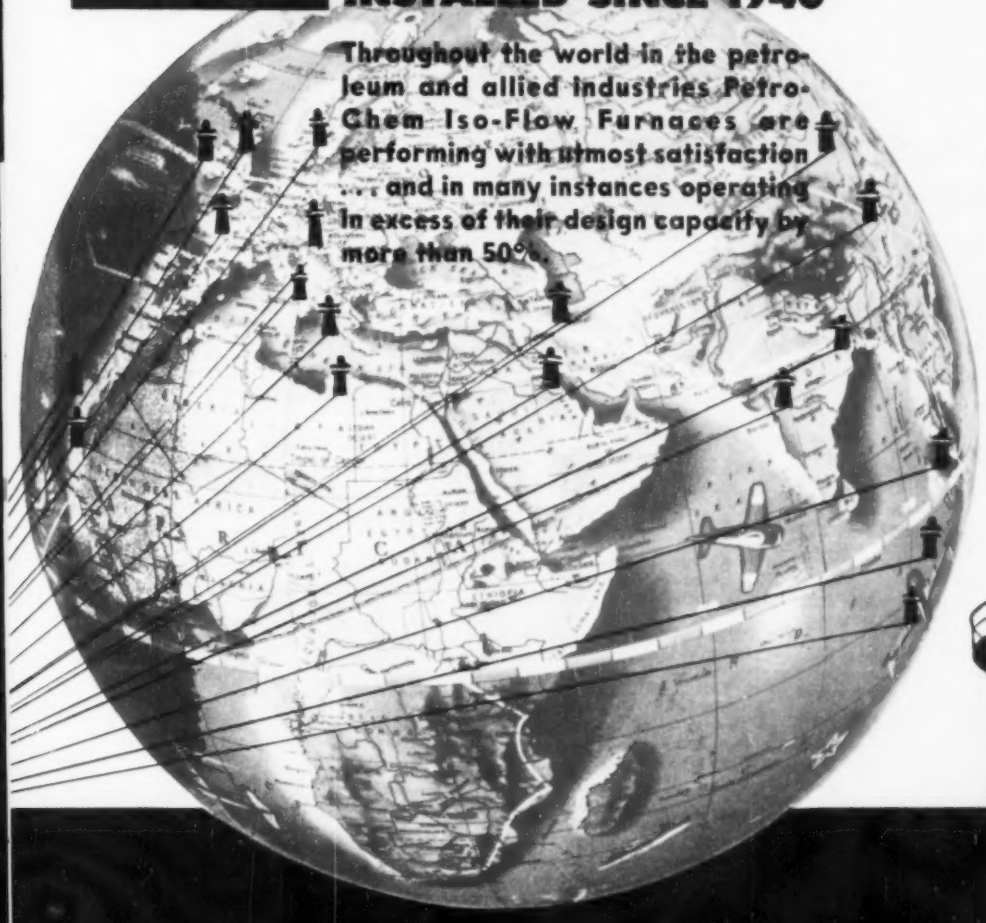

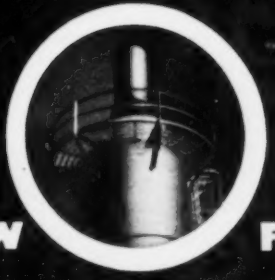

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Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

The practical data on gasoline plant operating problems given in this department this month is taken from papers and discussions presented at the Southern Regional Meeting of the Natural Gasoline Assn. of America, at Tyler, Texas, Oct. 14. The questions selected concern problems which are common to many plant operators.

As always, questions from readers are invited pertaining to the above or other features of gasoline and cycle plant operation

Practical Helps in Selecting Gasoline Plant Instruments

What are the practical considerations in selecting types and models of indicating and control instruments for natural gasoline and cycling plants?

Each instrument should be considered individually, with full thought on what is to be expected of it under the conditions imposed. The basic requirement is that it meet the specified needs and no more at the least possible cost—considering quality of measurement and control, required inherent flexibility, durability and simplicity for the lowest possible investment and maintenance costs.

Temperature:—In most temperature measurements fairly high accuracy and good sensitivity will be required. For controllers select a range placing the control point in the upper third of the chart. Consider suppressed ranges, which cost no more and give far greater readability, sensitivity and control response than one beginning at zero degrees. The lowest temperature should be just below values required both for start-ups and operation.

Bulb type thermometers are often used, with long distances between bulb and control room recorder. Consider short capillaries and pneumatic transmission to a recording receiver for rapid response instead of long runs of expensive capillary tubing and slow pen response. Transmitters are essentially trouble-free, so mount them if possible within 5 ft. of the measurement point instead of defeating their purpose by stringing 100 ft. or so of capillary tubing to get them off towers and to ground level. It is vital to keep the air supply dry.

Do not overlook the advantages of thermocouples, which have essentially no transmission lag and cannot be over-ranged. The potentiometer type instrument has proven particularly valuable on close fractionation control, heaters, interlocking controls and the like.

Pressure:—Pressure measurement on fractionators is most accurate with a suppressed range, the greater the better. Use as narrow a span as possible to aid in detecting the smallest variations and give the controller a chance to correct for them. Where very low gage pressures are involved, say 1 lb. with a 5-lb. chart range, select a standard chart and range where the desired reading will be close to the middle. In the case mentioned, select a range of minus 5 to plus 5 lbs. with center zero.

Where accurate vacuum measurements are important, an absolute pressure gage is suggested. This type has an evacuated bellows which compensates for barometric pressure changes and always gives a true absolute pressure indication. When connecting lines between instrument and pressure tap are very long, pneumatic transmission will eliminate frictional lags and dampening effects. Put the transmitter at the pressure tap with the shortest possible connection.

Flow:—Flow measurement quality almost always is a function of the installation details of the meter rather than choice of the basic instrument. Speedy pen response is the usual concern and, unless the meter is near the orifice plate, one must decide between direct connection and pneumatic transmission. If distance is short and a good slope can be obtained on the connecting lines, direct connection is satisfactory. Otherwise, use pneumatic transmission, and always where seals would otherwise be required to prevent freezing or vaporization.

Liquid Level:—General liquid level measurements are satisfied by conventional displacement type instruments and wide-range services by differential pressure measurement. Most of these instruments are easily equipped with all forms of automatic control, recording, pneumatic transmission and high and low level alarms.

Many difficult level measurement problems are being solved by the "Gagetron," which electronically determines the position of a guided float containing a small amount of radioactive material and indicates or controls via a potentiometer. No outside connections are made at the vessel or electric connections inside.

Quality of Control:—Most control problems in a natural gasoline plant are best met with proportional plus reset type controllers. Simple throttling controllers are generally used where first cost is very critical and where there is no objection to frequent manual adjustments to return the process to the control point. However, where load conditions change frequently, automatic reset is a material time-saver when the operator's attention is urgently required elsewhere, especially during process upsets and start-ups.

Pneumatic controllers equipped with rate response are able to give faster and closer control action on processes subject to large measurement or detection lags, sudden disturbances or load changes of considerable magnitude. For example, a simple throttling controller positions the valve in proportion to the amount of deviation; throttling plus reset further adjusts the valve in proportion to the amount and time duration of the deviation, and rate response further adjusts the valve position depending on the rate of change of deviation, with greater correction for faster changes.

Cascaded or interlocking control frequently is advantageous, using one instrument to reset another. An example is the use of a flow controller on the fuel supply to a heater, this instrument being reset by a temperature controller on the heater outlet. The flow controller will detect and correct flow variations long before the temperature controller senses the change. Another application is on de-ethanizer control, using the reflux accumulator liquid level controller to reset the heat input rate-of-flow controller and thereby maintaining a fixed reflux rate.

Control Valves:—The best measuring means and the finest controller are wasted if the wrong control valve is used. A large variety of inner valve plugs are available to meet various requirements; just one style plug will not do all jobs. Pressure drops should be determined by actual or calculated conditions, and not selected arbitrarily. Valve positioners

are needed to overcome stem friction and valve motor hysteresis in valves controlling high and extremely low temperature fluids and high pressure drops, whether the valve is large or small.

Every motor valve is installed with a by-pass valving arrangement. Consider the high-lift hand-control flow valve for this service. It has a characterized plug, stem travel indicator and threads are low-pitched to allow close adjustment. After using it a few times the operator will quickly learn about where it should be set.

Inherent Flexibility: — This property in the instrument chosen may be the best protection of the original investment, since it can be converted at little or no extra cost where the plant is revamped or enlarged. Temperature transmitters are readily relocated when short capillaries are used and range changes are inexpensive. Thermometers generally should be standardized as to level fittings by use of adjustable unions and there should be enough wells on vessels to permit ready relocation whenever desired.

There now is considerable interest in direct-reading flow controller charts instead of the 1-10 square root charts, which require a change of orifice plate with each change of conditions. The direct-reading chart for 100-in. meters has odd-size range tubes to match, available in steps which increase capacity about 25% each. By changing range tube and chart, both inexpensive, changing the orifice plate is avoided.

The final point in good instrumentation is to set up a schedule for regular preventive maintenance, keep a record of service performed and date, provide maintenance personnel with complete instruction bulletins and parts lists, and keep an adequate supply of repair parts.—C. F. Woods, Brown Instruments Division, Minneapolis-Honeywell Regulator Co., Dallas.

Causes of Corrosion When Sweet Gas Is Processed

What are the causes of corrosion in low and high pressure plant process equipment utilizing sweet gas?

The presence of air in low pressure inlet gas will accelerate corrosion, while in high pressure operation, with inlet gas ranging from 800 to 1800 psi., the pressure alone is sufficient to promote increased absorption of acid gas components in condensed water as well as increased absorption of these components in the circulating absorption oil.

Plant inlet gas containing carbon dioxide, hydrogen sulfide, carbonyl sulfide, methyl mercaptans and heavier, and possibly some air, all

The maintenance of expansion joints in difficult-to-service or remote locations is costly in both man-hours and shutdown losses. ADSCO *Corruflex* Packless Expansion Joints *eliminate* those costs by eliminating the causes. They never require packing or maintenance of any kind.

Corruflex Joints are on the job all the time . . . absorbing pipeline expansion and contraction resulting from temperature changes . . . protecting lines and equipment from undue strain.

And ADSCO *Corruflex* Joints are easy to install. Their compactness—with a maximum outside diameter scarcely larger than that of an ordinary flange—makes them ideal for use in trenches, tunnels or other cramped quarters where maintenance costs may be unusually high.

Like other ADSCO products, *Corruflex* Joints are built to the highest standards. They are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. They are supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex Joints have traverses ranging from fractions of an inch to 15" and will operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600 F.

For dimensions and further information, consult your ADSCO representative or send us your requirements for our recommendation. For descriptive literature, write for Folder No. P-149.

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STEAM TRAPS — STRAINERS — METERS
CASING — ANCHORS — GUIDES

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AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N. Y.

[*To obtain more data on advertised products see page* 80]

amounting to a total less than 2% by volume, may or may not become a problem immediately upon entering the plant. Often the operation is such that these components are concentrated further along in the process and there become a problem.

Corrosion in gas coolers has been experienced at relatively low pressure. In East Texas corrosion of Admiralty tubing in shell-and-tube exchangers for compressor discharge cooling has been experienced. The first stage discharge, at 35 psi. and 250° F., is free of tubular corrosion failure, but the same gas elevated to 300 psi. and 250° F. attacks tubing of both the discharge cooler and the following gas chiller, the latter preceded by a separator removing condensate and water.

The metal attack is characterized by formation of a loose black deposit, underlain by a more firmly adherent gray and blue-green precipitate. Brushing this away, grooving and pitting is noted. Chemical analysis indicates some iron and copper sulfide, but largely copper carbonate with some copper sulfate. The attack is believed due to more of the acid gas being absorbed in the condensing water at the high stage pressure.

Solutions proposed are (1) neutralization of acidic constituents by chemical injection, (2) removal of water by dehydration and (3) use of specific resistant metals. Type 304, 18-8 stainless steel has shown some promise of resisting the attack although it will cost twice as much as Admiralty. Full scale tests indicate about six times the Admiralty service life can be expected. An alloy of 70-30 cupro-nickel is under full-scale test now, paralleling an Admiralty bundle and comparable to stainless being tested in a similar installation.

Should stainless be the answer, it may be less expensive than plant chemical treatment or dehydration, since chemical treating equipment also may be expected to require stainless steel.

A cycling plant on the Gulf Coast is experiencing corrosion of plug valves in inlet gas piping and forged carbon steel headers of atmospheric section gas cooler headers handling gas at 2500 psi. and 130° F. from distillate wells. The headers are drilled, tapped and plugged opposite the end of each tube to permit tube replacement; corrosion is experienced in the tapped plug holes.

Straight drilled holes with shouldered plugs now are preferred and, while chemical injection at the well head affords partial protection of the coolers, complete protection may require further chemical injection just ahead of the coolers.

Acid gas components in compression products and high pressure absorption products do not spend themselves on the first metal contacted. Wherever water is condensed in the process with these components present, corrosion will be experienced; the intensity will vary with gas velocity, pressure and temperature. The hot oil entering a still may be the source of CO_2 and H_2S corrosion within the vessel; stripping steam may further increase corrosion by contributing additional CO_2 and perhaps some oxygen.

Corrosion was experienced at an East Texas plant in the main still, operating at 135 psi. and 370° F., penetration of the shell in the area of the feed tray occurring only five months after it was installed, new. Stainless steel elements in the top three trays withstood the deep grooving attack of acidic water draining down the vessel shell. Similar still operation at 90 to 100 psi. and comparative temperature has shown no corrosive attack.

The acidic water resulted from carbon dioxide in both gas and utility stripping steam, possibly accelerated by oxygen and minute amounts of sulfur compounds. Steam condensate withdrawn from the dehydrating trays of the vessel had a pH value of 4.3 and contained 210 ppm. of iron in solution.

A 3% by weight solution of aqua ammonia was injected into the vessel feed stream. The ammonia flashed from solution upon entering the vessel and was absorbed by condensing steam along with the carbon dioxide. Following treatment the water had a pH value of 8.0 and zero parts of iron in solution. An excessive injection rate must be avoided if still condensers are of brass or Admiralty metal tubes. Injection should be controlled to produce a pH not to exceed 8.5 for the still overhead water condensed.

Piping from de-ethanizer fractionator condensers to reflux accumulator, and the reflux accumulator also, are subject to corrosive attack from carbon dioxide and hydrogen sulfide concentrated in this system. It is suggested that piping from shell-and-tube condensers to accumulators, usually consisting of short lengths, should be replaced with Type 304 stainless steel or thick wall pipe where corrosion has been experienced.

Thorough inspection of equipment at regular intervals is valuable. Permanent records of inspection data and complete records of equipment failure attributed to corrosion can greatly assist future equipment maintenance and replacement.—J. H. Nashke, Gas Division, Humble Oil & Refining Co., Houston.

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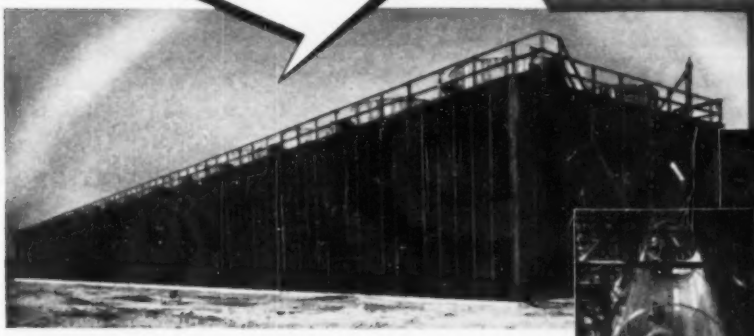
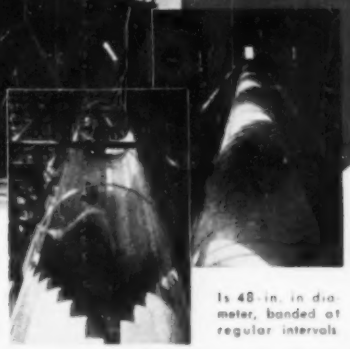


Redwood Main Distribution Header at top of Cooling Tower is over 400 ft. long.

The world's largest... 51,000 gals. of water per minute... 3,060,000 gals. per hour... 73,440,000 gals. of water per 24-hour day... cooled to a guaranteed temperature with this 34-cell Multi-Stage, Redwood Induced Draft Cooling Tower, engineered especially for Lube Plant in Louisiana.



Is 48 in. in diameter, banded at regular intervals

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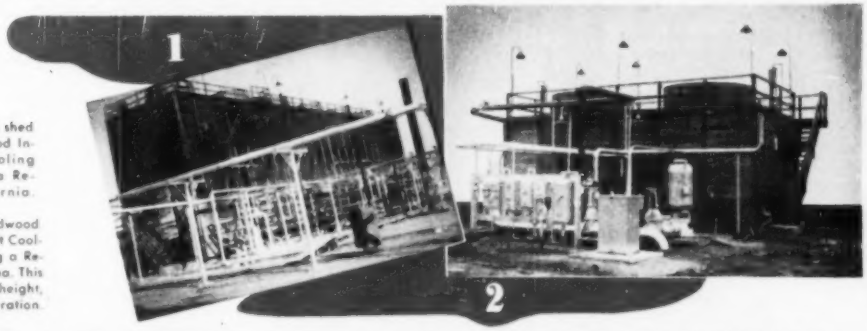

1. Six-Cell, coil shed type, Redwood Induced Draft Cooling Tower serving a Refinery in California.

2. Two-Cell, Redwood Induced Draft Cooling Tower serving a Refinery in Oklahoma. This Tower, is low in height, economical in operation.

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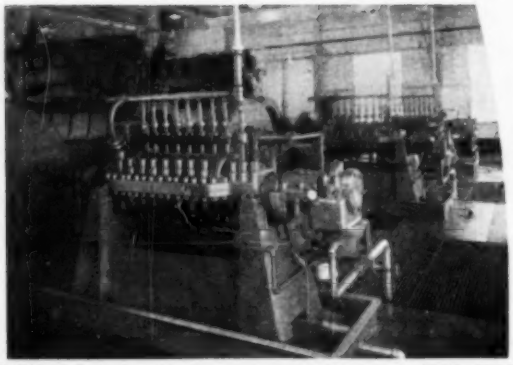

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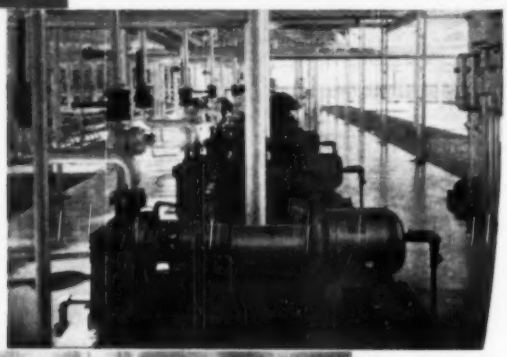
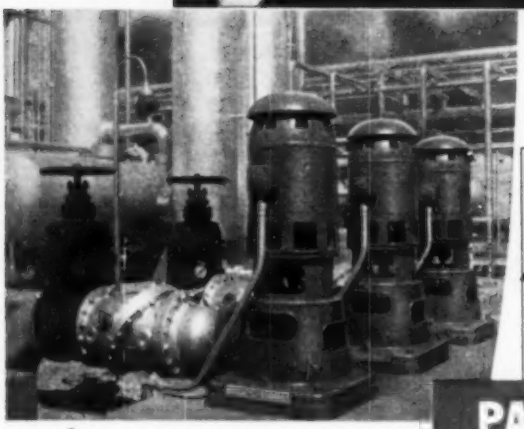


24 Single and Two-Stage Pumps Types SVC . . . SEC . . . DH and RVC handle – Lean Oil . . . Rich Oil . . . Gasoline . . . Propane . . . Butane . . . Ethane.



6 Type CT Pumps are in Cooling Tower Service.

Pacific Pumps inc.

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WRITE FOR BULLETIN 1

PR 8

Efficient Grid Design Provides Enlarged Regeneration Zone

In addition to the improved grid design described below, this month's review of new and improved devices used in petroleum processing and handling operations on which patents have been issued recently includes:

- **Special Venturi prevents plugging in solids injector**
- **Bubble cap holder enables one man to do work of two**

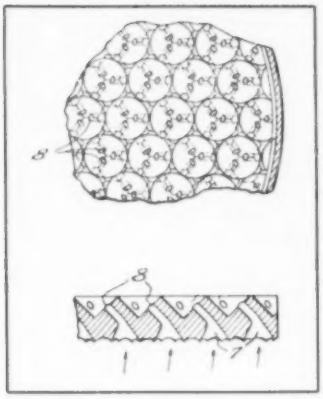


Fig. 1—Plan and sectional views of improved grid plate design for catalyst conversion chambers (U. S. 2,487,984)

AN IMPROVED DISTRIBUTION plate, or grid, for the bottom end of fluid type regeneration vessels is said to maintain uniform flow and diffusion of the charge stream while permitting greater use of the lower section of the contacting chamber.

Instead of being placed at the point between the lower inlet cone and the cylindrical body of the chamber itself, this grid can be located within the cone and just above the inlet conduit. As a result it can be made very much smaller than conventional practice requires.

The general design is shown in the sketches in Fig. 1. It comprises a series of closely positioned, tapered inlets 7, each of which leads to a small sloping hole 8 on the upper, or outlet side of the plate. The holes are so arranged, in groups of three, that each of the streams of a given group will converge in a common point.

U. S. 2,487,984, issued November 15, 1949, to Hugh Rodman, assignor to Universal Oil Products Co.

Special Venturi Design Stops Plugging in Solids Injector

JAMMING OF SOLIDS cannot occur in an improved design for injecting granular materials into a fluid stream, it is stated, because of the use of a series of interconnected Venturi tubes, as shown in the drawing in Fig. 2.

In operation, solids flow down from hopper 1 through the openings 31, 32, 33, and 34 of the series of Venturi tubes. Fluid under pressure coming in through line 5 is blown out the nozzle 7 and passes through flaring sections 29, 28, 27, and 26 into outlet line 2, picking up the granular material as it passes through the injector.

Jamming is eliminated for two reasons: 1) the high velocity of the jet through the series of Venturis and 2) the fact that the Venturis are all connected by a common framework allows vibrations to be transmitted from tube to tube, thus tending to free material which might be jammed temporarily in any single Venturi.

U. S. 2,483,911, issued Oct. 4, 1949, to Herschel R. Lamborn, assignor to Phillips Petroleum Co.

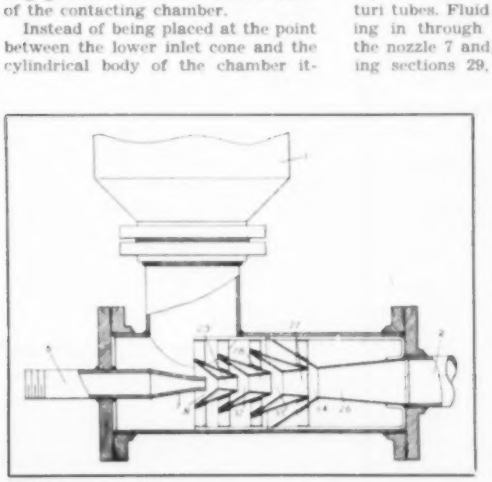


Fig. 2—Series of Venturi tubes reduce posible jamming during the injection of solids into a fluid stream (U. S. 2,483,911)

One Man Does Work of Two With New Bubble Cap Holder

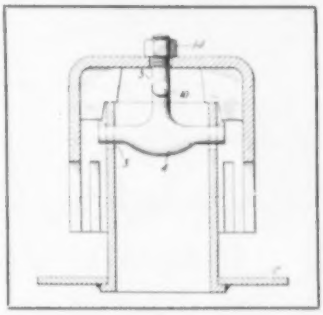


Fig. 3—Bubble cap holder is self-centering and enable one man to install caps (U. S. 2,488,249)

BUBBLE CAPS can be installed in fractionating towers by one man instead of the customary two or three by using an improved, self-centering, securing device.

Fig. 3 illustrates the device in place in a bubble cap assembly. Risers are perforated at diametrically opposite points 3, to receive the one notched cross bar 4 of the holder. The other cross bar 10 on the holder is at right angles to bar 4 and rests on the upper rim of the riser, thus preventing the holder from dropping through the riser.

Shank 5 is threaded so the bubble cap can be fastened down with nut 14 by the man working above the tray 2. The notches on cross bar 4 insure proper positioning of shank 5 in the center of the riser. Conventional procedure, it is said, involves: 1) a man below tray 2 to insert a T-bolt up through the riser and tack-weld it to the riser, and 2) another man above the tray to install the caps.

U. S. 2,488,249, issued November 15, 1949, to Bradford C. White, assignor to Stone & Webster Engrg. Corp.

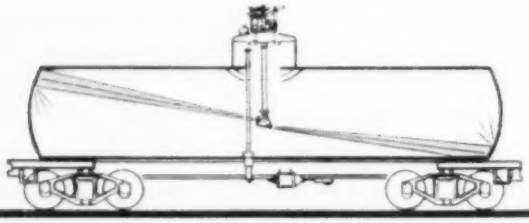
Classified Patents Listing, p. 76

Patents Issued in November

The following classified listing covers patents issued during the month of November believed to be of interest or value to petroleum processing and handling operations.

Catalytic Processes

2,482,911 (Phillips Petroleum Co.)—Catalyst injector.
2,485,316 (Std. Oil Development Co.)—Slide valve.
2,486,650 (Phillips Petroleum Co.)—System for adding solids to liquids under pressure.
2,487,717 (Calif. Research Corp.)—Apparatus for controlling catalyst regeneration.
2,487,984 (Universal Oil Products Co.)—Fluid distributing plate.
2,488,027-2,488,028 (Std. Oil Co., Indiana)—Catalytic converter.
2,488,032 (Std. Oil Co., Indiana)—Catalytic converter.
2,488,249 (Stone & Webster Engrg. Corp.)—Bubble cap securing device.
2,488,406 (Gulf Research & Development Co.)—Method and apparatus for conducting chemical reactions.
2,488,488 (Socony-Vacuum Oil Co., Inc.)—Method and apparatus for conversion of fluid hydrocarbons.
2,488,493 (Socony-Vacuum Oil Co., Inc.)—Apparatus for conducting gas-solid contact operations.
2,489,863 (Lummus Co. and Jeffery Mfg. Co.)—Catalyst regenerator.
2,489,925 (Lummus Co.)—Catalyst feeder.



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MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. & Canada

Processing, General

2,486,691 (John T. Travers estate)—Apparatus for purifying sewage and industrial wastes.
2,487,104 (Std. Oil Development Co.)—Pressure vessel safety device.
2,487,370 (Stratford Development Corp.)—Contactor and separator for low-density solids.
2,487,981 (The Girdler Corp.)—Method and apparatus for removing carbon monoxide from gaseous mixtures.
2,488,884 (Shell Development Co.)—Apparatus for contacting immiscible liquids.
2,489,681—2,489,682 (Equipment Development Co., Inc.)—Rotary filter and filter element.
2,489,768 (F. G. Firth)—Electro-magnetic device for accelerating reactions.
2,489,903 (Lummus Co.)—Flash chamber.
2,489,944 (Lummus Co.)—Heat exchanger.

Pumps & Compressors

2,486,590 (David W. Criswell)—Reciprocating pump for hot or gritty and abrasive fluids.
2,486,649 (William C. Heath)—Jet pump.
2,486,939 (Phillips Petroleum Co.)—Stuffing box for high speed rotary pump.
2,487,230 (Aro Equipment Corp.)—Shaft seal.
2,488,157 (Charles E. Bassano)—Centrifugal compressor and evacuator.
2,489,191 (H. H. Looke)—Fluid seal for rotating shafts.
2,489,491 (Lon-Son Development Co.)—Pulsation absorber.
2,489,800 (C. G. Muller)—Rotary abutment pump or motor.
2,489,887 (Roots-Connersville Blower Corp.)—Rotary pump for hot gases.

Valves

2,488,380 (Alfred C. Danks)—Butterfly valve.
2,488,596 (Std. Oil Development Co.)—Snap-acting mechanism for steam engine valves.
2,489,450 (Std. Oil Development Co.)—Valve assembly for plural motor operation.

Instruments

2,486,823 (Socony-Vacuum Oil Co., Inc.)—Compensating means for liquid level indicators.
2,487,266 (Taylor Instrument Cos.)—Pneumatic controller.
2,487,650 (Fluid Control Engrg.)—Pressure regulator.
2,487,876 (Bailey Meter Co.)—Separator trap.
2,488,269 (General Electric Co.)—Non-contacting thickness gauge.
2,489,294 (Phillips Petroleum Co.)—Variable flow gas sampling apparatus.
2,489,893 (Bailey Meter Co.)—Apparatus for purifying and feeding sample gas.
2,489,949 (Socony-Vacuum Oil Co., Inc.)—Method of controlling a fractionating column.
2,490,010 (Minneapolis - Honeywell Regulator Co.)—Measuring and controlling apparatus.

Tools

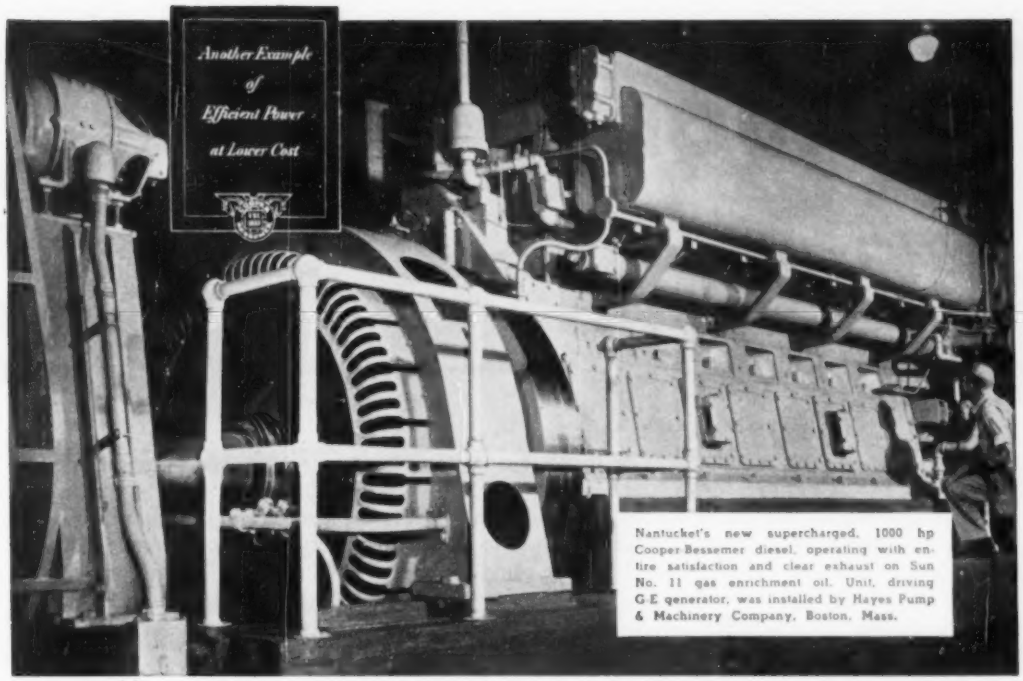
2,486,639 (Bert C. Ferguson estate)—Oil thief.
2,486,755 (James A. Mitchell)—Pipe wrench with inner jaw actuated by rotatable handle.
2,487,281 (Glenn Steckelberg)—Toggle actuated wrench with hydraulic control.
2,487,987 (J. R. Schmitt and S. E. Hickerson)—Clutched head wrench with spring-pressed wedging ball.
2,488,461 (Stanley W. Wysocki)—Lift truck.
2,488,633 (O. A. Linder and E. J. Klause)—Ladder safety step.
2,488,933 (A. S. F. Randolph)—Driver and extractor for stud bolts.
2,489,057 (E. J. St. Laurence)—Wrench.
2,489,443 (W. W. Williams)—Pipe thread cleaning tool.

Laboratory Apparatus

2,487,161 (William L. Mellon)—Explosive-proof test tube heater.
2,488,812 (L. S. Galstaun and D. D. Thomas)—Gas analysis apparatus.
2,488,995 (G. A. Thiberg)—Non-sparking pump for gases and liquids.
2,489,370 (R. L. Fowler)—Liquid and gas separator.

Miscellaneous

2,486,624 (Cardox Corp.)—Discharge apparatus for fire-fighting with carbon dioxide.
2,487,410 (Cook Electric Co.)—Flexible expansion joint.
2,487,998 (John H. Wiggins)—Dry seal pressure type gas holder.
2,488,784 (Hartford National Bank and Trust Co.)—Device for passing a rotary shaft through a wall in a gas-tight manner.
2,489,844 (Zallea Bros.)—Welded steel units for expansion joints.



Nantucket's new supercharged, 1000 hp Cooper-Bessemer diesel, operating with entire satisfaction and clear exhaust on Sun No. 11 gas enrichment oil. Unit, driving G-E generator, was installed by Hayes Pump & Machinery Company, Boston, Mass.

Nantucket's New Diesel Burns Heavy Fuel

SAVES $11,950 A YEAR!

NANTUCKET Gas & Electric Company urgently needed additional power capacity. Their aging steam turbine plant was hardly adequate. After carefully weighing all factors, a supercharged Cooper-Bessemer diesel was picked for the job!

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Secondly, extremely close speed regulation was essential. The new unit was to be paralleled with the turbine generators and was to power an aircraft radio beam requiring exceptional cyclic control. Here again Cooper-Bessemers offered proved performance.

These and other problems in this unusual installation, *including the elimination of smoke*, despite the heavy fuel, were overcome right from the start. Consequently, the new engine went into service at once. And, by burning heavy fuel instead of regular diesel fuel, it is estimated that the new Cooper-Bessemer will save $11,950 a year at present fuel rates.

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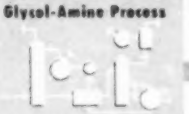
Now, for the first time, the Mathieson *Sasco Process for the commercial recovery of elemental sulfur from waste hydrogen sulfide gas is available to operators of petroleum refineries and natural gasoline plants. An agreement between The Fluor Corporation, Ltd., and Mathieson Chemical Corporation designates Fluor as the sole licensing agent for the engineering and construction of sulfur recovery plants incorporating Mathieson's Sasco Process. All details, including first studies, are available through Fluor.

SOUR NATURAL GAS

Hydrogen sulfide gas in sour residue gas from gas-gasoline operations is a large potential source of elemental sulfur.

FLUOR
Glycol-Amine Process

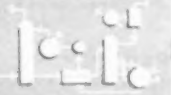


for the recovery of H_2S from sour gases

SOUR REFINERY GAS

Hydrogen sulfide gas in sour refinery gas from the processing of sour crude oil is a potential source of elemental sulfur.

FLUOR
Gas-Treating Process

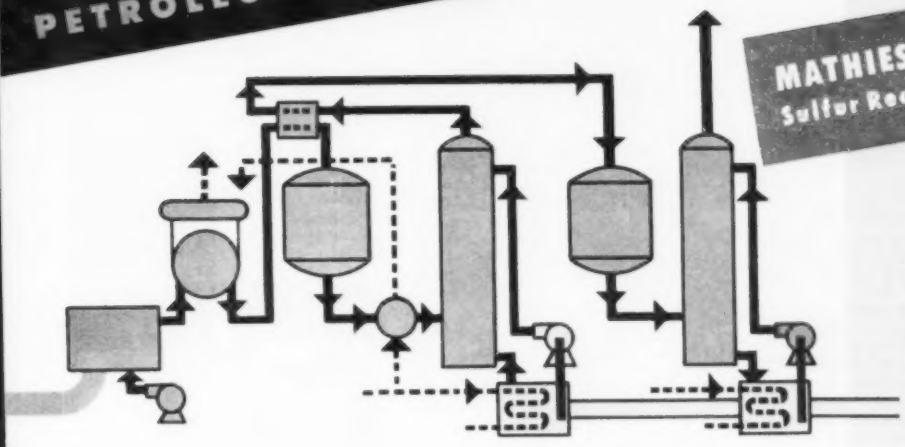


for the recovery of H_2S from sour refinery gases

* *The first Sasco Process Plant was built by Southern Acid and Sulfur Company in 1942. Acquisition of this company by Mathieson Chemical Corporation, and continued research and development by Mathieson personnel mark this process for recovery of sulfur from waste hydrogen sulfide gas as the only one developed in the United States with a record of several years' successful operation.*

RECOVERY
PETROLEUM GASES

MATHIESON-SASCO
Sulfur Recovery Process



MATHIESON-SASCO PROCESS

A gas stream containing hydrogen sulfide gas, such as the acid gas effluent from an amine plant, is partially burned with air—the heat being utilized for steam production. The combustion gases are passed through a catalyst where SO_2 and H_2S react to form sulfur and water vapor. Elemental sulfur is then recovered from the gas stream by contacting with liquid sulfur in wash towers. The residue gas containing nitrogen, carbon dioxide and water vapor is vented to the atmosphere.

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Personals

Ralph R. Matthews retired Dec. 31 as executive vice president of Battenfeld Grease & Oil Corp., Kansas City, after a long career as a technologist in the petroleum industry, most of it in the field of lubricating oils and greases.

After graduation from the University of California he became a junior chemist in the Petroleum Division of the U. S. Bureau of Mines when its personnel consisted of a director and two junior chemists. He later joined Shell Oil Co. and, among other capacities, was acting superintendent of the Wood River refinery when the first Dubbs cracking plant was built. He became head of the lubrication department of Roxana Petroleum (later Shell Oil), leaving in 1928 to become vice president in charge of sales of Battenfeld Grease & Oil Corp.

Mr. Matthews was instrumental in organizing the Division of Petroleum Chemistry of the American Chemical Society in 1921 and was chairman for four years. He has been active in the National Lubricating Grease Institute and in the work of Committee D-2 on Petroleum Products and Lubricants of the American Society for Testing Materials, particularly in the lubricating oil and grease field. He also assisted in organizing the Kansas City Section of the Society of Automotive Engineers. After retirement he and Mrs. Matthews plan to spend some time in travel to points as yet unvisited.

* * *

Dr. Mott Souders, Jr., head of the chemical engineering research section of the Shell Development Co., San Francisco, was presented the top chemical engineering award for 1949 at the annual meeting of American Institute of Chemical Engineers in Pittsburgh, Dec. 6.

Dr. Souders, Jr.

Dr. Souders was given the $1000 Professional Progress Award in Chemical Engineering. He is best known in chemical engineering for his method of calculating the size of a fractionating column. Dr. Souders, 45, joined the Shell Development Co. in 1937.

* * *

F. E. Thompson has been appointed safety director of the Warren Petroleum Corp., with headquarters in Tulsa. He was formerly superintendent of the company's natural gasoline plant in the Cumberland field near Madill, Okla.

Mr. Thompson started with Warren as a field man in 1928, and advanced steadily until he became superintendent of the Fry gasoline plant in Brown County, Texas, in 1933. He was later transferred to Warren's new gasoline plant at Fairbanks, Texas, as superintendent, and then made superintendent of another new plant at Salem, Ill. From there he went to the Madill plant.

George Ford succeeds Mr. Thompson as superintendent at the Madill plant. Mr. Ford joined the Warren organization when the Gladewater, Texas, plant was purchased from the Hanlon companies. At that time he was assistant superintendent at Gladewater. He later was promoted to superintendent of the Graham, Okla., plant.

* * *

Dan M. Guy has been appointed assistant director of Technical Service in Ethyl Corp.'s research laboratories at Detroit. In addition to his new duties he will continue as head of the agricultural section of technical service, a post he has held for four years. Mr. Guy joined Ethyl in 1931 as a field engineer.

In other shifts at the Detroit laboratory, **John D. Bailie** has been transferred to the agricultural section of technical service, and **M. A. Remondino** to the commercial engine and fleet section. Mr. Bailie joined Ethyl in 1939 and has been stationed at Detroit for the past two years as a research engineer in the commercial engine and fleet section. Mr. Remondino for the past three years has been assigned to Ethyl's road test laboratory at San Bernardino, Calif.

* * *

Joseph L. Mikita is assistant technical manager in the Petroleum Chemicals Division of the Du Pont Co. He was formerly director of its Petroleum Laboratory at Deepwater Point, N. J. He is a graduate in mechanical engineering from Pennsylvania State College, received his master's degree there in 1933, and was a research assistant there for three years. Later he was in research work for The Texas Co., becoming associate director of research. He went with Du Pont in 1946.

Milton H. Campbell succeeds Mr. Mikita as director of the Deepwater Point laboratory. He graduated in chemical engineering at the University of Michigan in 1938, and received a master's degree from Case Institute of Technology in 1941. He was engaged in research work for Standard Oil Co. of Ohio, joined Du Pont in 1947, and had recently been head of the engineering division of the Deepwater Point laboratory.

Iver T. Rosenlund has been moved by Du Pont to Wilmington to engage in technical service work. He had been manager of the Road Testing Laboratory at El Monte, Cal. He graduated in mechanical and aeronautical engineering at University of Michigan in 1937 and came to Du Pont in 1947 after technical work with aircraft engine companies.

* * *

M. P. Venema, formerly head of the patent department of Universal Oil Products Co., was elected a vice president of the company at a recent meeting of the Board of Directors.

Mr. Bockman

A graduate of Armour Institute of Technology (now Illinois Institute of Technology) and Georgetown University in law, Mr. Venema has been associated with Universal since 1935. From 1941 to 1944 he represented the firm's patent department in Washington, and in June of the latter year returned to Chicago to direct the activities of that department, a position he held until elected vice president.

Mr. Venema

In addition to electing Mr. Venema a vice president, the Directors also elected **George A. Bockman** treasurer. Mr. Bockman was formerly assistant treasurer and has been with Universal since 1922. At one time he served as purchasing agent of the company, and was made assistant treasurer in 1941.

* * *

Dr. George M. Saunders has been appointed medical director for overseas operations of the Socony-Vacuum Oil Co. He was previously associate director of the medical department of Monsanto Chemical Co.

Dr. Saunders is a native of Superior, Wisc., and was graduated from Harvard University Medical School cum laude in 1925. He will be headquartered in New York City, where Socony's main offices are located.

* * *

The retirement of **X. R. Smith**, package superintendent of Atlantic Refining Co.'s Point Breeze refinery, has led to a series of organizational changes in the refinery management. Replacing Mr. Smith is **F. W. Ander-**

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Personals

son, formerly mechanical superintendent. That position is now being filled by former lubricating superintendent **J. S. Patchin,** who is succeeded by his assistant, **I. M. Perkins.**

* * *

Joseph E. Pogue, petroleum economist, has been elected a Gulf Oil Corp. director and will also serve the company in a consulting capacity. He has given up his position as vice president of Chase National Bank, New York, but will act in an advisory capacity to the bank. He studied at the University of North Carolina, Yale and Heidelberg University, then held positions with Smithsonian Institution and the U. S. Geological Survey and in 1914 became associate professor of geology and mineralogy at Northwesten University.

During World War 1 he served as assistant director of the Bureau of Oil Conservation, U. S. Fuel Administration and later joined Sinclair Consolidated Oil Corp. as manager of economic research. Dr. Pogue set up his own consulting engineering firm in 1920 and joined Chase National Bank in 1936. He is a member of the National Petroleum Council and of the advisory committee on economics of the Interstate Oil Compact Commission.

MEETINGS . . . for the Oil Man

JANUARY

9-13, **Society of Automotive Engineers,** Annual Meeting and Engineering Display. Book-Cadillac Hotel, Detroit.

16-19, **First Plant Maintenance Show,** Public Auditorium, Cleveland.

23-27, **American Standards Assn.;** Seminar on Industrial Standardization, Engineering Societies Building, New York.

FEBRUARY

12-16, **American Institute of Mining & Metallurgical Engineers,** Annual Meeting. Pennsylvania Hotel, New York.

26-Mar. 1, **American Institute of Chemical Engineers,** Regional Meeting. Rice Hotel, Houston.

27-Mar. 3, **American Society for Testing Materials,** Committee Week and Spring Meeting. Hotel William Penn, Pittsburgh.

MARCH

26-30, **American Chemical Society,** 117th National Meeting (divided), Houston.

27-29, **Western Petroleum Refiners Assn.,** 35th Annual Meeting, Plaza Hotel, San Antonio.

APRIL

3-6, **National Assn. of Corrosion Engineers,** Jefferson Hotel, St. Louis, Mo.

9-13, **American Chemical Society,** 117th National Meeting (divided), Philadelphia.

10-12, **American Society of Lubrication Engineers,** Hotel Statler, Detroit.

10-14, **American Society of Mechanical Engineers,** Hotel Statler, Washington.

12-14, **National Petroleum Assn.,** Semi-Annual Meeting, Hotel Cleveland, Cleveland.

16-20, **American Chemical Society,** 117th National Meeting (divided), Detroit.

24-26, **Natural Gasoline Assn. of America,** 29th Annual Convention, Texas Hotel, Fort Worth.

24-26, **American Society of Mechanical Engineers,** Process Industries, William Penn Hotel, Pittsburgh.

24-27, **American Management Assn.,** 19th National Packaging Exposition, Navy Pier, Chicago.

MAY

2-5, **American Petroleum Institute,** Refining Division, Annual Spring Meeting, Hotel Cleveland, Cleveland.

28-31, **American Institute of Chemical Engineers, Regional Meeting,** New Ocean House, Swampscott, Mass.

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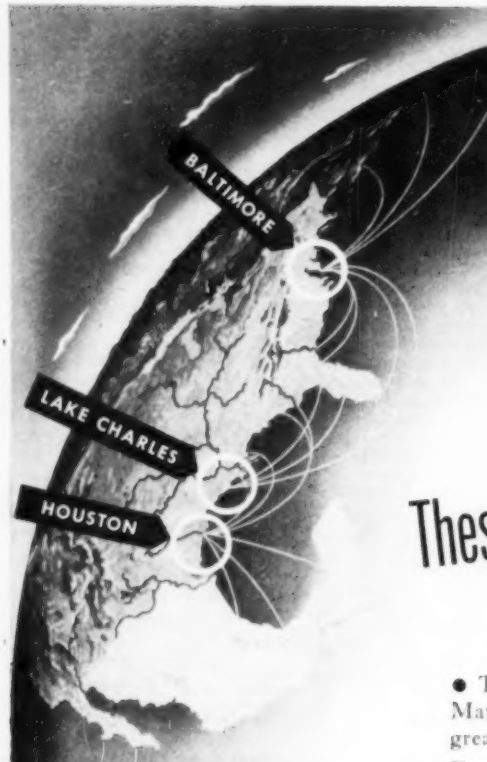
Houston 6, Texas

[To obtain more data on advertised products see page 80]



These Routes Lead to Economy

● To serve customers more economically, Mathieson has strategically located not one but three great tide-water plants.

From these deep-water ports Mathieson is able to move economically large tonnages of heavy chemicals, new, improved fertilizers and special chemicals through low-cost shipping over inland waterways, along the coast or across the seven seas.

Reflected also in Mathieson chemicals are the customer benefits accruing from the efficient handling of incoming raw material at these tide-water ports.

Mathieson's constantly improving and expanding facilities for research, production and delivery are the result of one aim — to provide chemicals for the betterment of industry, agriculture and public health.

Mathieson
CHEMICALS

Mathieson Chemical Corporation
MATHIESON BUILDING,
BALTIMORE 3, MARYLAND

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

[To obtain more data on advertised products see page 80]

REFINING TRENDS

Residual Fuel Stocks Low in the East

CHANGES in stocks of principal refined products during the last quarter of 1949 show an improved economic status for refiners at the start of 1950, even though the total volume of stocks is several million barrels larger than at the start of 1949. The improved situation is particularly true as regards fuel oil stocks, both light and heavy, east of the Rockies.

For the entire U. S., stocks of gasoline, kerosine, distillate and heavy fuel oil were cut by around 7,000,000 bbls. during the last three months of 1949, the total being about 271,000,000 bbls. on Dec. 24th. During the last three months of 1948 stocks increased over 19,000,000 bbls. for the country. The total was around 262,000,000 bbls. Dec. 25th.

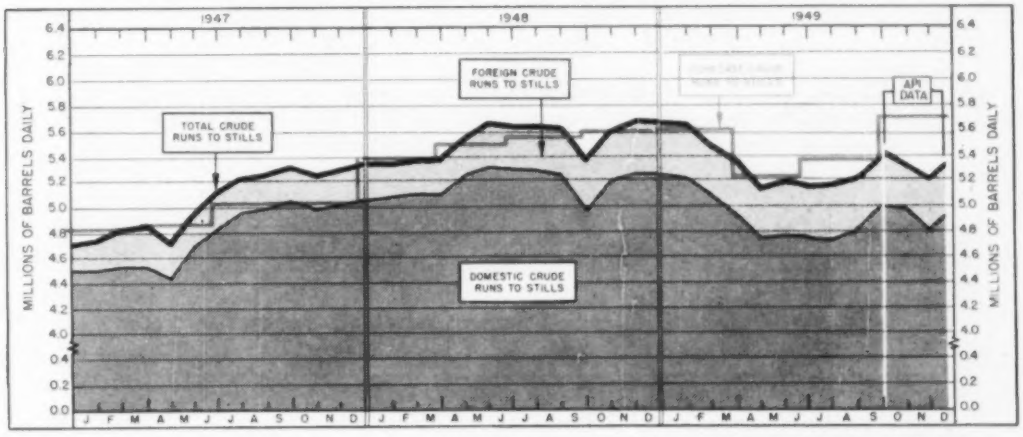
The change for the two quarters under comparison is more striking for the fuel oil stocks (distillates and residuals). For the last quarter of 1949 there was a decrease in total fuel oil stocks of over 15,500,000 bbls. for the U. S. About 5,000,000 bbls. of this was in heavy fuels in California, and 10,000,000 bbls. in kerosine and distillate fuels over the rest of the country. There was only minor change in heavy fuel oil stocks east of the Rockies.

In the last quarter of 1948 all fuel oil stocks increased about 7,000,000 bbls., the increase, however, being confined almost entirely to residual fuel oil stocks in California.

Gasoline stocks for the U. S. the latter part of December, 1949, were 110,000,000 bbls., around 6,000,000 bbls. higher than at the same period in 1948. Most of this gain has been in California. Gasoline stocks for the rest of the country, 92,500,000 bbls. are about 1,000,000 bbls. higher than at the close of 1948.

The status of residual fuel stocks for the entire country is not accurately reflected in Fig. 7 below. While the total figure for stocks at the end of 1949 is about the same as at the end of 1948, there has been a wide divergence in the trend of these stocks in California as compared with the rest of the country. In California stocks of heavy fuels increased from around 24,000,000 barrels in January to around 35,000,000 barrels in the latter part of December. For the rest of the country the trend has been downward, from over 38,000,000 barrels in January to around 26,000,000 barrels in the latter part of December.

Fig. 1—Runs to Stills—Moderate Increase in December


1947
1948
1949
MILLIONS OF BARRELS DAILY
TOTAL CRUDE RUNS TO STILLS
FOREIGN CRUDE RUNS TO STILLS
DOMESTIC CRUDE RUNS TO STILLS
API DATA
J F M A M J J A S O N D

Yields on Crude Run to Stills

(Bureau of Mines Data)

	Gasoline	Kerosine	Dist. Fuels	Resid. Fuels
October, 1949, %	42.4	5.5	19.3	20.9
October, 1948, %	40.7	5.6	19.6	22.6
October, 1947, %	40.4	5.6	17.6	23.7

End-of-Month Inventories, Refinery Products, 1000 bbls.

	Gasoline	Kerosine	Distillate	Residual	Total
Nov. 30, 1949 (API data)	105,115	25,545	89,455	66,619	287,734
Oct. 31, 1949 (B of M data)	103,287	27,609	90,643	68,673	290,213
Nov. 30, 1948 (B of M data)	95,580	25,820	83,969*	77,023*	282,350*

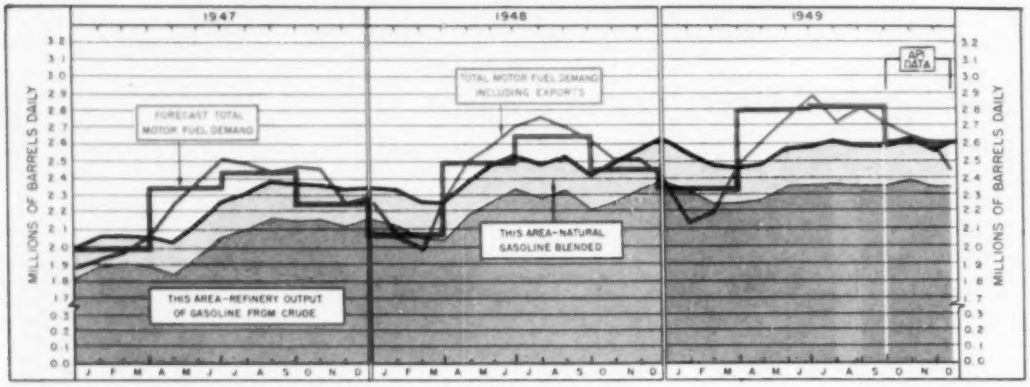
* Old basis of reporting.

U. S. Refinery Operations, bbls

	Crude Runs to Stills			Motor Fuel Supply			Distillate Production			Residual Fuels		
	Domestic	Foreign	Total	Gasoline from Crude	Natural Blended Used Direct	Total	Kerosine	Distillate	Total	Refinery Production	Imports	Totals
Dec., 1949, b/d avg.*	4,886,000	503,000	5,363,000	2,350,000	310,000	2,660,000	337,000	1,023,000	1,360,000	1,148,000	295,000**	1,443,000
Dec., 1948, b/d avg.	5,207,800	412,700	5,720,500	2,396,000	200,000	2,626,000	350,000	1,106,000	1,456,000	1,299,000	171,000	1,470,000
Change in 1949, b/d avg.	—447,800	+90,300	—357,500	—46,000		—36,000	—13,000	—83,000	—96,000	—151,000	+124,000	—27,000
	(8.6%)	(21.9%)	(6.3%)	(1.5%)		(1.3%)	(3.7%)	(7.5%)	(6.6%)	(11.6%)	(72.5%)	(1.8%)
10 Mos., 1949, 1000 bbls.	1,491,558	125,476	1,617,014	708,939	89,346	798,285	82,124	278,659	360,783	352,126	57,184	409,310
10 Mos., 1948, 1000 bbls.	1,583,918	99,251	1,683,169	675,820	83,254	759,074	100,154	313,931	414,085	387,550	43,760	431,310
Change in 1949, b/d avg.	—92,360	+26,225	—66,135	+33,119	+5,592	+38,711	—18,030	—35,272	—53,302	—35,415	+13,424	—22,001
	(5.7%)	(26.6%)	(3.9%)	(4.9%)	(6.7%)	(5.0%)	(18%)	(11.2%)	(12.9%)	(9.1%)	(30.7%)	(5.3%)

* Through Dec. 24, 1949; ** Estimated.

Fig. 2—Motor Fuel—Seasonal Decline in Demand


1947
1948
1949
MILLIONS OF BARRELS DAILY
FORECAST TOTAL MOTOR FUEL DEMAND
TOTAL MOTOR FUEL DEMAND INCLUDING EXPORTS
API DATA
THIS AREA—NATURAL GASOLINE BLENDED
THIS AREA—REFINERY OUTPUT OF GASOLINE FROM CRUDE
J F M A M J J A S O N D

The motor fuel demand line and the forecast demand line include, in addition to refinery gasoline and natural gasoline blended at refineries, a varying volume of natural gasoline used direct as motor fuel. This volume averages around 70,000 b/d.

Fig. 3—Gasoline Stocks—Rise 5,000,000 Bbls. in Month

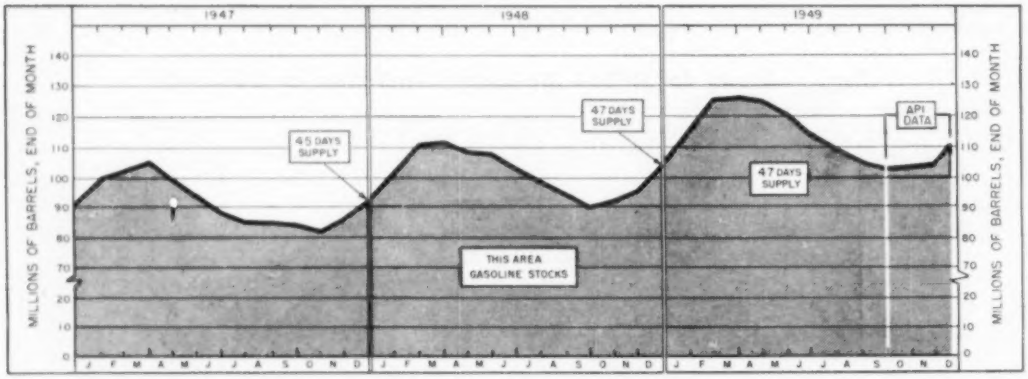


Fig. 4—Distillate Fuels—Demand at High Point for Year

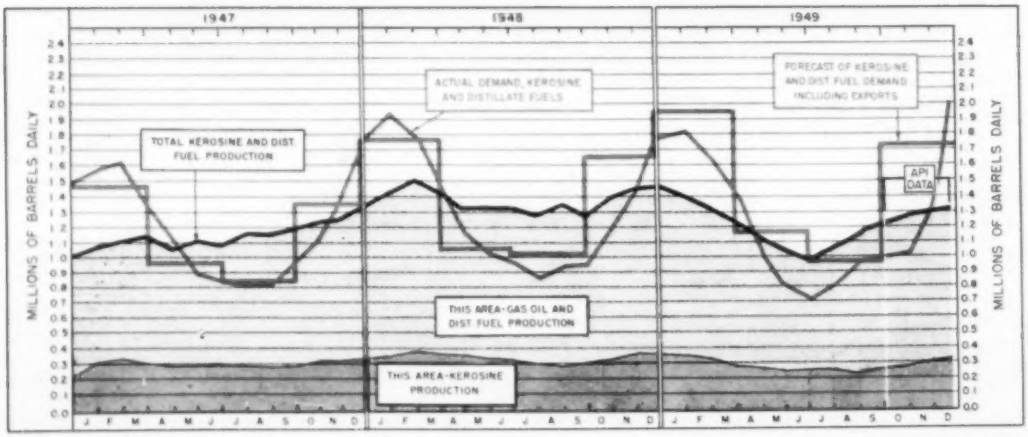
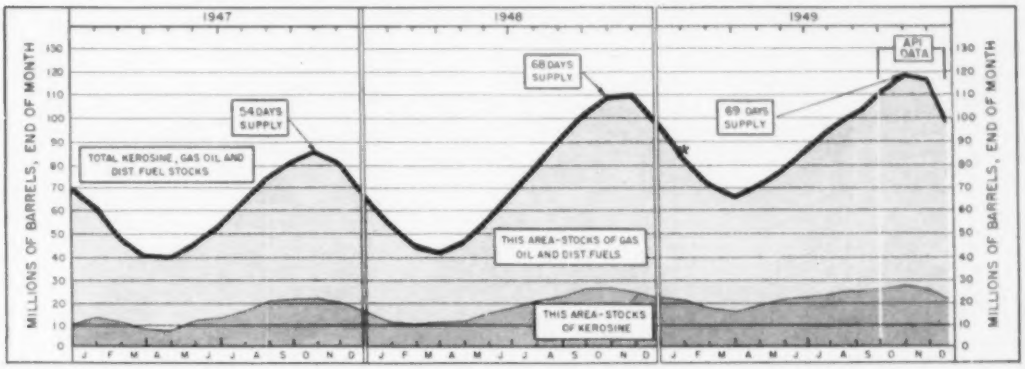

1947
1948
1949
MILLIONS OF BARRELS DAILY
TOTAL KEROSINE AND DIST FUEL PRODUCTION
ACTUAL DEMAND, KEROSINE AND DISTILLATE FUELS
FORECAST OF KEROSINE AND DIST FUEL DEMAND INCLUDING EXPORTS
API DATA
THIS AREA-GAS OIL AND DIST FUEL PRODUCTION
THIS AREA-KEROSINE PRODUCTION
J F M A M J J A S O N D

Fig. 5—Distillate Stocks—Drop Just under 100,000,000 Bbls.


1947
1948
1949
MILLIONS OF BARRELS, END OF MONTH
54 DAYS SUPPLY
TOTAL KEROSINE, GAS OIL AND DIST. FUEL STOCKS
68 DAYS SUPPLY
THIS AREA-STOCKS OF GAS OIL AND DIST. FUELS
THIS AREA-STOCKS OF KEROSINE
69 DAYS SUPPLY
API DATA
J F M A M J J A S O N D

* Change in reporting in California eliminated 4,500,000 bbls. from distillate classification.

Fig. 6—Residuals—Continued Sharp Increase in Demand

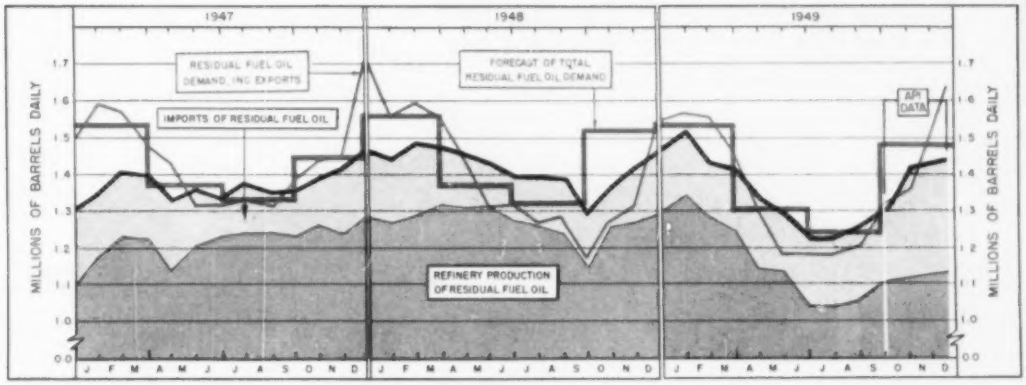
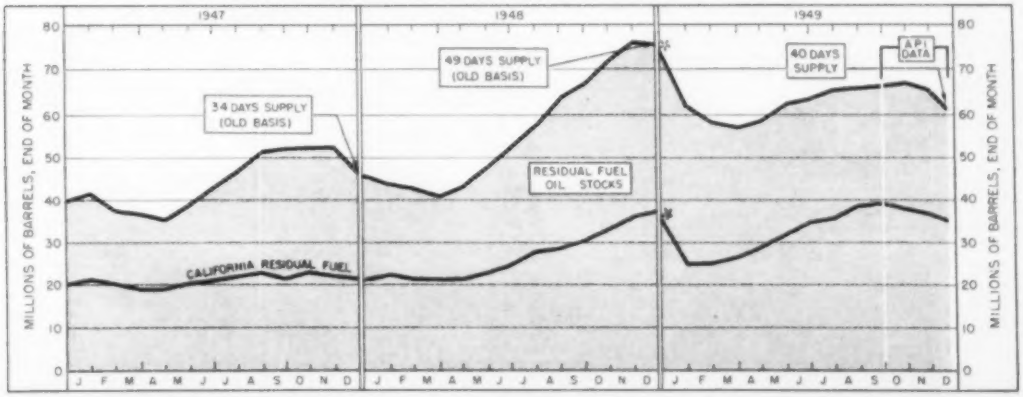

1947
1948
1949
MILLIONS OF BARRELS DAILY
RESIDUAL FUEL OIL DEMAND, INC. EXPORTS
IMPORTS OF RESIDUAL FUEL OIL
FORECAST OF TOTAL RESIDUAL FUEL OIL DEMAND
REFINERY PRODUCTION OF RESIDUAL FUEL OIL
API DATA
J F M A M J J A S O N D

Fig. 7—Residual Stocks—At Low Level East of Rockies



* Change in reporting in California eliminated 13,000,000 bbls. from residual classification.

Fig. 8—Production of Natural Gasoline and Production Forcast

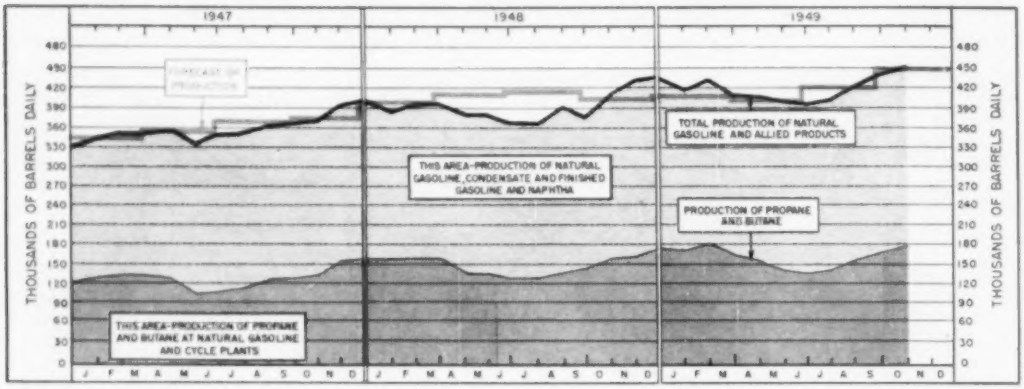
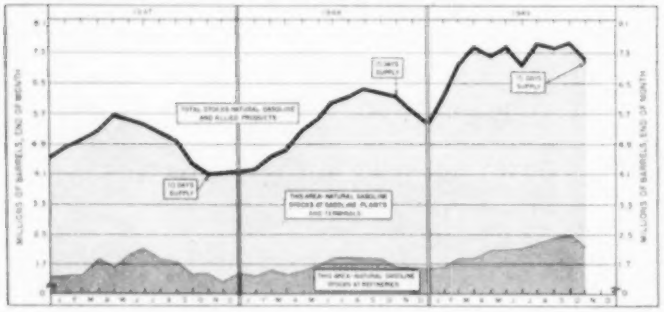

1947
1948
1949
THOUSANDS OF BARRELS DAILY
THIS AREA-PRODUCTION OF PROPANE AND BUTANE AT NATURAL GASOLINE AND CYCLE PLANTS
THIS AREA-PRODUCTION OF NATURAL GASOLINE, CONDENSATE AND FINISHED GASOLINE AND NAPHTHA
TOTAL PRODUCTION OF NATURAL GASOLINE AND ALLIED PRODUCTS
PRODUCTION OF PROPANE AND BUTANE
J F M A M J J A S O N D

Fig. 9—Stocks of Natural Gasoline

(Days supply figured in terms of current demand)

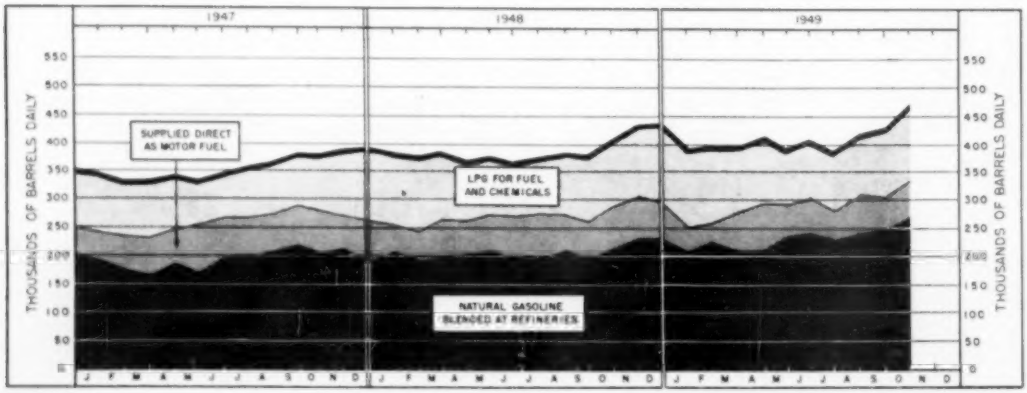

MILLIONS OF BARRELS, END OF MONTH
TOTAL STOCKS NATURAL GASOLINE AND ALLIED PRODUCTS
10 DAYS SUPPLY
THIS AREA NATURAL GASOLINE STOCKS AT GASO. AND CYCLE PLANTS AND TERMINALS
THIS AREA NATURAL GASOLINE STOCKS AT REFINERIES
J F M A M J J A S O N D

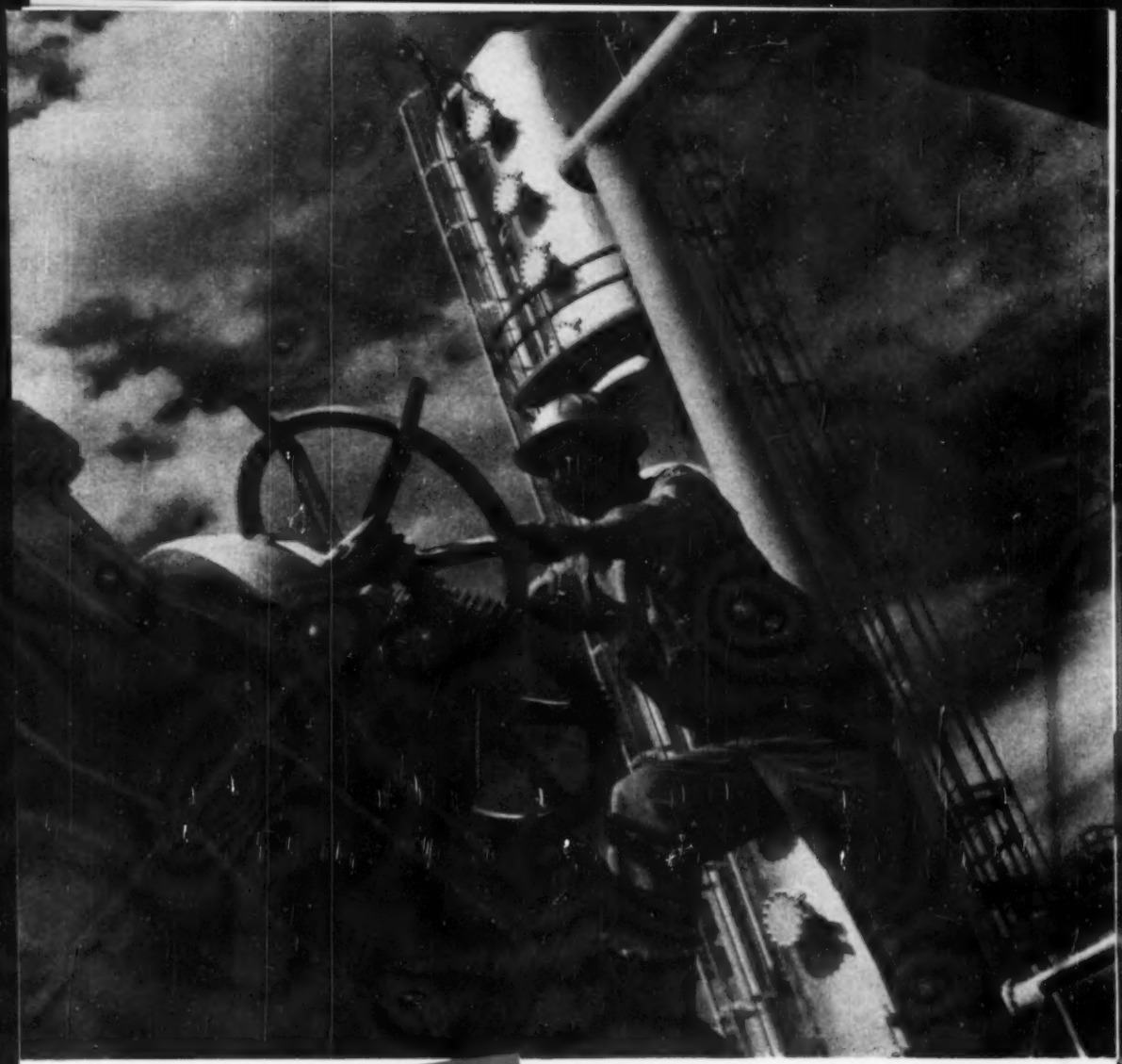
Natural Gasoline Statistics

(Bureau of Mines Data)

	Propane & Butane	Heavier Naturals	Total
	—Production, b/d, avg.—		
October, 1949	179,000	271,000	450,000
October, 1948	158,000	257,000	415,000
Change in 1949	+21,000 (14.7%)	+14,000 (5.5%)	+37,000 (8.9%)
	—Total Production, 1000 Bbls.—		
10 Months, 1949	48,000	79,000	127,000
10 Months, 1948	42,500	75,800	118,500
Change in 1949	+5,400 (10.1%)	+3,200 (4.2%)	+7,500 (6.3%)
	—Principal Demand, b/d, avg.—		
	Blended at Refineries	Supplied Direct as Motor Fuel	LPG for Fuel & Chemicals
October, 1949	268,000	62,000	137,000
October, 1948	214,000	76,400	121,000
Change in 1949	+54,000 (25.2%)	—14,400 (18.8%)	+16,000 (13.2%)
	—Total Demand, 1000 Bbls.—		
10 Months, 1949	70,683	17,577	35,847
10 Months, 1948	62,141	20,340	33,543
Change in 1949	+8,542 (13.7%)	—2,763 (13.5%)	+2,304 (6.8%)
	Stocks, End of Month, 1000 Bbls.		
	Refineries	Gasoline Plants	Total
October, 1949	2,092	4,831	6,923
October, 1948	1,627	4,546	6,173
Change in 1949	+465 (28.5%)	+285 (6.3%)	+750 (12.1%)

Fig. 10—Principal Demand for Natural Gasoline


1947
1948
1949
THOUSANDS OF BARRELS DAILY
SUPPLIED DIRECT AS MOTOR FUEL
LPG FOR FUEL AND CHEMICALS
NATURAL GASOLINE BLENDED AT REFINERIES
J F M A M J J A S O N D



Easier than ever to operate

Kept fully lubricated, automatically

Maintenance time deeply cut

Self-feeding, self-sealing

Leakage avoided, automatically

•

Ask for Bulletin V-211 describing Hypermatic Lubricant

Nordstrom Valve Division

ROCKWELL MANUFACTURING CO.

400 N. Lexington Avenue • Pittsburgh 8, Penna.

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa.
Also leading supply houses
Export: Rockwell Manufacturing Co., International Division, 7701 Empire State Building, New York 1, N. Y.

NEWS OF

Manufacturers—Suppliers—Engineering Firms

Serving the Petroleum Processing Industry

Mechanical Foam Tests Succeed

Fireman demonstrates deep blanket of foam laid down within 3 minutes during test at varnish plant tank car siding

Depositing a 7-in. blanket of fire-extinguishing foam over an area 25 to 40 ft. wide and about 150 ft. long in three minutes, an automatic deluge type sprinkler system redesigned for handling mechanical foam liquid was shown entirely satisfactory in recent tests in a Schenectady varnish plant.

The installation protects a long tank car unloading siding and adjoining tankage containing volatile solvents, thinners, and the like. Mechanical foam, the famed wartime Navy "bean soup," differs radically from the more familiar chemical foam in that it is a mass of mechanically formed air bubbles in place of chemically formed CO_2 bubbles. It is a stable, hydrolyzed protein made from a soya bean base by National Foam Systems, Inc., and called "Aer-O-Foam" liquid. When mixed 6% by volume with water, it forms a tough foam blanket capable of flowing around obstacles, clinging to rounded surfaces, such as tank walls, and putting out fires involving gasoline, benzol, naphtha, and other flammable liquids.

The deluge equipment in the varnish plant, built by "Automatic" Sprinkler Corp. of America, comprises three distributing systems for the area under protection. Each system has 16 to 17 overhead foam discharge heads. Pressure at these heads is about 75 psi., giving a total foam discharge of about 8800 gpm. per system. In the tests, foam discharge at full efficiency was reached 20 seconds after the heat actuating devices set off the system. Total foam liquid actually used during the 3.3 minute run was 190 gals.

Ductile Cast Iron to be Produced

A new ductile cast iron which, unlike ordinary cast iron, can be bent or twisted, is now being made available by International Nickel Co., with the recent granting of patents covering the results of years of research and development by the company.

The new material is said to combine the processing advantages of cast iron, such as fluidity, castability and machinability, with many of the product advantages of steel. The essential feature is the introduction into and retention by the molten iron under treatment of a small amount of magnesium. This produces a new graphite structure which is in the form of spheroids, eliminating a substantial portion of the usual weakening flake graphite. Under stress the material behaves elastically like steel rather than cast iron, having proportionality of strain to stress up to high loads with a modulus of elasticity of about 25 million psi.

Ethyl Awards Scholarships

The award of eight university scholarships to as many American educational institutions, and in the fields of interest to the petroleum, automotive, and chemical industries has been announced by Ethyl Corp. Carrying an aggregate value of $12,000, the 1949-1950 awards continue a program begun by Ethyl in 1937.

Becker Up at Midwest Piping

Phil R. Becker has been appointed sales manager of the welding fittings division of Midwest Piping & Supply Co., Inc., with headquarters at the executive offices in St. Louis. Mr. Becker joined the company 10 years ago in the engineering dept. He moved over to the welding fittings division in 1941, in engineering and production control.

Shell Installs Flue Gas Snubber

The Burgess-Manning Co. has contracted recently to supply a flue gas exhaust snubber on the discharge of the catalyst regenerator in the fluid catalytic cracking unit of the new Shell Oil Co. refinery addition at Montreal, Canada.

The unit is similar, it is stated, to the installation on the Fluid unit at the Lima refinery of Standard Oil Co. (Ohio). Other recent installations of the company's noise and vibration equipment have been made at Ohio Oil Co., Robinson, Ill.; Rock Island Refining Co., Zionsville, Ind.; Continental Oil Co., Billings, Mont.; and Cosden Oil & Refining Co., Big Springs, Texas. Snubber installations are now under construction also on Fluid units at Globe Oil & Refining Co., Lemont, Ill.; and Wood River Oil & Refining Co., Hartford, Ill.

NALCO Starts Catalyst Manufacture

Mr. Averill

With the formation of a new Catalyst Division, National Aluminate Corp. is now in production of a ground silica-alumina catalyst for fluid catalytic cracking units. Manufacturing facilities are at Nalco's Plant 2, 4001 West 71st Street, Chicago, purchased in 1946 from the Defense Plant Corp. While little catalyst has been produced since that time, research and development work has continued. With the completion of an addition and the installation of new equipment, production has been resumed.

Plans are underway for development of a microspherical catalyst in addition to the ground type. Gage Averill, for the past several years with American Cyanamid Co. as supervisor of sales in the petroleum chemicals dept., has joined Nalco as sales manager of the Catalyst Division.

New Branches, Distributors

Industrial Models, of Wilmington, Del., has opened a new shop at 67 Fulton St., New York City, to serve engineering and construction firms and staffs in that area, particularly those in the petroleum and chemical fields.

Graver Water Conditioning Co.— Four new district sales engineering representatives have been appointed.

A REPORT of PROGRESS
Ground was broken for the Cosden "Cat" Cracker January 25, 1949. The unit was completed October 28, in only 194 working days — 33 less than the estimated completion time. Treco Contracts are Completed on Time.
COSDEN'S
(Big Spring, Texas)
New Fluid "Cat" Cracker
Constructors
The REFINERY ENGINEERING Company
Licensors
UNIVERSAL OIL PRODUCTS COMPANY
Charge capacity, 6,000 barrels daily of West Texas sour gas oils.
REFINERY ENGINEERING Co.
Phone 5-5561
Tulsa, Oklahoma

WeldOlets, Butt Welding — Available as standard, with outlet sizes from ⅛" to 24", both straight and reducing for use with Schedule 40 pipe up to 12" outlet. Outlet sizes 12" - 24" for standard weight pipe (⅜" wall). Also available for Schedule 80 services through 8" outlet and extra strong through 24" outlet size (for use with pipe having ½" wall).

You write

SPEED, ECONOMY AND FULL PIPE STRENGTH

***into the job when you specify* WELDOLETS**

With WeldOlet branch pipe welding fittings you provide the quickest, most economical, most satisfactory method of obtaining full pipe strength at branch connections.

Note in the above illustration how the WeldOlet tapers to provide a single bevel groove joint at the crotch section and blends into a V-butt joint at the ear portion.

WeldOlets need no additional reinforcement to establish and fully maintain original strength on ASTM A-106 Seamless Steel Grade A Pipe, as set forth in Code for Pressure Piping, American Standards Association, B31.1-1942, and Supp. No. 2, B31.1-b-1947.

To meet special conditions, these fittings can be furnished in any forgeable metal including wrought iron, toncan iron, nickel, Monel, Everdur, stainless grades 304, 316, 347, etc.

For detailed engineering reference data, write for Catalog W-2.

BONNEY FORGE & TOOL WORKS

Forged Fittings Division, 368 Green Street, Allentown, Pa.

Authorized Canadian Factory Representative:

Sterling Steel Co., Ltd., 20 Temperance Street
Toronto 1, Canada

WELDOLETS

FOR WELDED BRANCH PIPE OUTLETS

WeldOlets, Socket Welding — Available as standard, with outlet sizes ⅛" - 10", both straight and reducing, for use with Schedule 40 pipe. Also available in Schedules 80 and 160 up through 4" outlet size.

ThredOlets — Available as standard, with outlet sizes ⅛" - 10", both straight and reducing, for use with Schedule 40 pipe. Also available in Schedule 80 up through 2" outlet size.

Fig. 1 — Cut-away view of reducing size WeldOlet with welding outlet in place. The external rib and wide bases or footings of WeldOlets eliminate the need for extra supports to take care of bending or vibrational stresses at crotch section, the point of greatest stress.

Fig. 2 — Note blending of ear portion of welding fitting to run pipe. Extension of weld metal below inside scarfed portion of pipe insures all sections of joint greater than pipe wall thickness.

News of Suppliers

Russell R. MacDonald Co. will cover the Richmond, Va., territory, with headquarters in Atlantic Life Bldg., Richmond 19. J. R. Fortune & Son will represent Graver at Detroit, Stapp Engrg. Co. at Denver, Colo., and Process Equipment Co. at Tulsa, Okla.

Personnel Changes

Fluor Corp. — George H. Dieter, with the firm since 1940 in engineering and sales capacities, has been named general sales manager, with headquarters in the home office at Los Angeles. R. E. Nagel has been appointed assistant sales manager in charge of the Chicago office. Mr. Nagel has been in the petroleum industry since 1921, when he joined Universal Oil Products Co. He was with UOP until 1945, when he came with Fluor.

American Cyanamid Co.—Dr. Wilbur H. Miller, previously at the Stamford, Coan., research laboratories of the company, has been sent to Washington, D. C., as technical representative and assistant manager of that office.

The Foxboro Co.—Joseph M. Temple has been appointed manager of the Baton Rouge office at 115 N. 19th St., succeeding John B. Deaderick, now manager at Tulsa. Mr. Temple, in addition to four years in the Air Force, has been associated previously with J. B. Beaird Co. of Shreveport, and Petroleum Engrg. Inc., at Houston.

W. C. Hardesty Co.—New officers elected in December at New York home offices were: A. F. Kitchel, president; W. J. O'Connell, and E. Jobbins, vice presidents; F. R. Cantzlaar, secretary and treasurer. Mr. Hardesty is no longer connected with the company either as a director or as an officer.

Oliver United Filters Inc.—C. W. Crumb, formerly Chicago office manager, has been namd sales analyst, with headquarters in New York. Glen G. Reed, who for some time has worked out of the Chicago office, will take over as manager of sales in that territory.

Selas Corp. of America—Stuart A. Whitehurst has been named Pacific Coast representative. With headquarters at 11168 Santa Monica Blvd., Los Angeles, he will represent the firm throughout the Pacific Coast area.

National Supply Co.—Edwin A. Booth has been appointed general manager of sales of the Spang-Chalfant Division. He has been a member of the National Supply organization since 1929.

[*To obtain more data on advertised products see page* 80]

You *specify* the service . . . We'll *supply* the RIGHT valve

This may sound like a broad statement, but we can prove it. Because of the completeness of the Powell Line, we are always able to supply the *right* valves to meet the requirements of every industrial flow control service.

You specify the conditions under which the valve must operate. Usually your Powell distributor will know which is the right Powell Valve to meet them. If the conditions present a problem he can always consult Powell Engineers, or if you prefer, write to us direct.

At all events be sure you install the *right* valves—it's easy to do with the Powell Line.* Failure to do so will mean faulty performance instead of the long, trouble-free operation you can expect from the right Powell Valves.

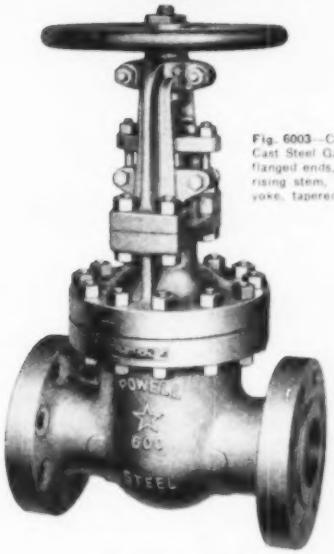


Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium nickel-bronze disc.

Fig. 375—200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

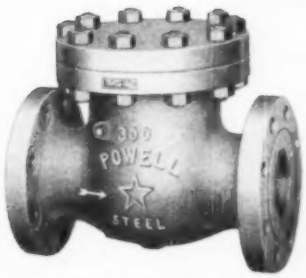


Fig. 3061—Class 300-pound Cast Steel Swing Check Valve with flanged ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", incl. Has outside screw rising stem, bolted flanged yoke, tapered solid wedge.

*The Complete Powell Line includes Globe, Angle, Gate, Check, Relief and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-Resisting metals and alloys.

Ask your nearest Distributor—or write direct

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

ADVERTISERS' INDEX

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Ketchum, MacLeod & Grove

(B) AMERICAN DISTRICT STEAM CO. 59
Squier & Davis, Inc.

(C) BADGER MFG. CO. 86
Tippett, Jackson & Nolan

(D) BADGER & SONS CO., E. B. 4-5
Harold Cabot & Co., Inc.

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(F) BONNEY FORGE & TOOL WORKS 78
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(H) CHEMICAL CONSTRUCTION 6
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(AJ) WOLVERINE TUBE DIVISION 51
Charles M. Gray & Assoc.

This index is published as a convenience to the reader. Every care is taken to make it accurate but PETROLEUM PROCESSING assumes no responsibility for errors or omissions.

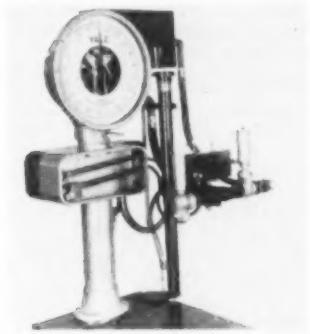
(The italic lines below name of the advertiser identify company's advertising agency)

What's New!

EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

Reviewed by WILLIAM C. UHL, Equipment Editor

1—Automatic Drum Filler



Completely automatic air operation is employed in a new drum filling device which can be used in hazardous atmospheres. Manufacturer states the unit will fill a 52-gal. drum with SAE 30 oil at 95° F. in 49 secs., within 6 oz. of desired weight. It operates on 80 to 150 psi. air pressure, preferably 100 psi. Simple operation will permit one man, unskilled, to handle one or two units. It is shown in the photograph mounted on a standard "Load King" scale. Yale & Towne Mfg. Co.

2—Grease Gelling Agent

Mallinckrodt Aluminum Stearate Technical D-50 has been developed primarily for use in the lubricating grease industry. It is said soap costs may be reduced as much as 50% through the use of D-50 as a gelling agent. Laboratory and field trials with variety of oils and operating conditions have shown the greases using the product, even at low soap concentrations, possess good resistance to mechanical breakdown and have high dropping points, even texture, and high bleed resistance. Mallinckrodt Chemical Works.

For More Information

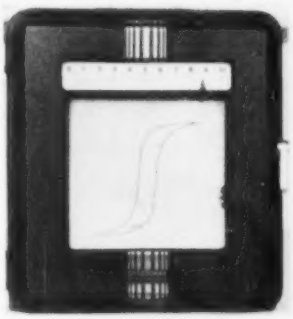
Use one of the attached reply cards to request additional information or literature on any items reviewed in "What's New!" Just check the numbers corresponding to the numbers on the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage required.

3—Hydrogen Sulfide Mask

Extra long service life is claimed as a feature of a new gas mask effective against hydrogen sulfide and petroleum vapors. The oversize canister is said to furnish protection for a period twice as long as that required for U. S. Bureau of Mines approval. Since it is not air-supplied, it cannot be used inside tanks or any confined space where the oxygen content may fall below 16%. It will be useful to tank gaugers, pumphouse men, inspectors, and repairmen. Willson Products, Inc.

4—Recorder Plots Two Variables

A new L&N Speedomax Recorder now automatically plots the relationship between two variables, showing one as a function of the other, thus



eliminating tedious compilation and manual plotting by personnel. The operation is obtained by two measuring circuits. Pen travel (X axis) is controlled by the "Speedomax G" electronic circuit. A similar circuit controls the chart paper drive (Y axis), and makes it reversible. Thus it is possible to draw curves automatically for such factors as temperature vs. temperature difference, stress vs. strain, hysteresis loop, and many others. Pen travel time is 3 seconds for full scale of 9⅞ in. Full chart travel is 10 in. and requires 4 seconds. Standard minimum input voltage for full travel of X coordinate is 2.5 millivolts, while the Y coordinate requires a minimum of 10 millivolts for full travel. Leeds & Northrup Co.

5—Ten Ton Day Oxygen Plant

Stacey-Dresser Engrg. has announced the immediate availability now of standard 10-ton/day oxygen plants. Using normal atmospheric clean air as raw material, the unit will produce 10.5 gross tons/day at 95% purity. It can be accommodated on 32 x 24 ft. of floor space. The cold box requires 10 x 8 x 32 ft., which encloses ¾ of the fractionator and all exchangers and cold piping. Other custom-built plants are available in sizes up to 1000 tons per day. Stacey-Dresser Engrg.

When you need piping equipment

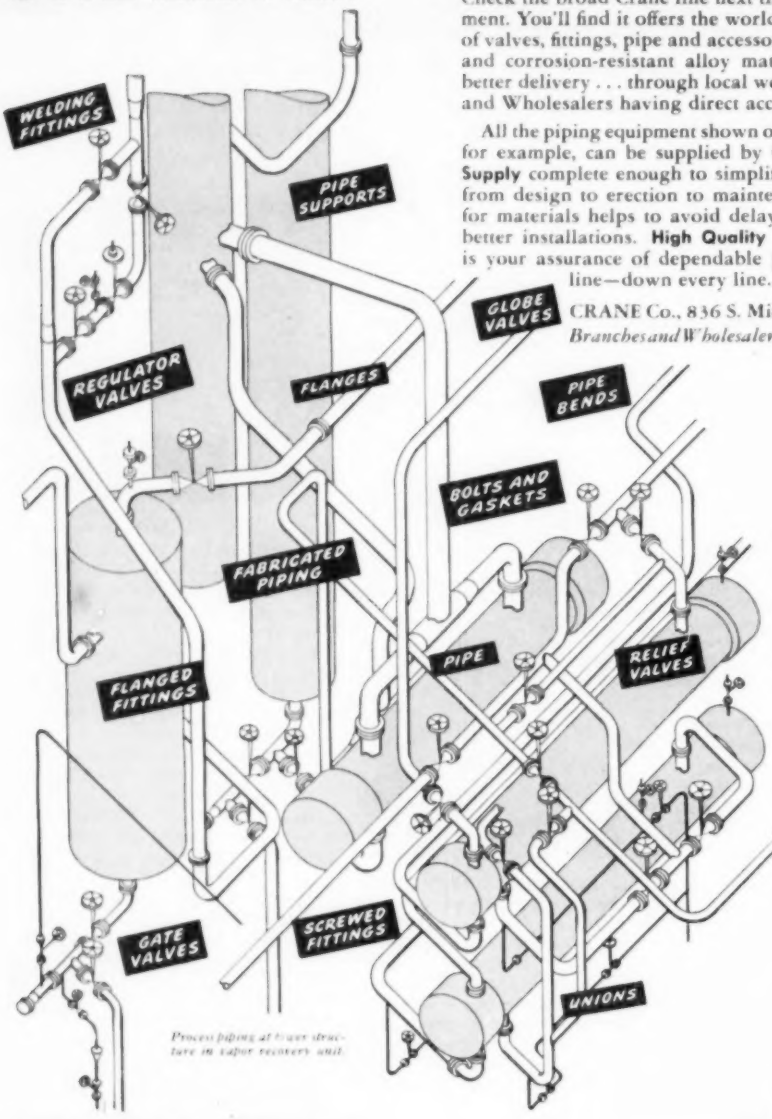
ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

...What you need is CRANE

Check the broad Crane line next time you need piping equipment. You'll find it offers the world's most complete selection of valves, fittings, pipe and accessories . . . in brass, iron, steel and corrosion-resistant alloy materials. One order brings better delivery . . . through local well-stocked Crane Branches and Wholesalers having direct access to large factory stocks.

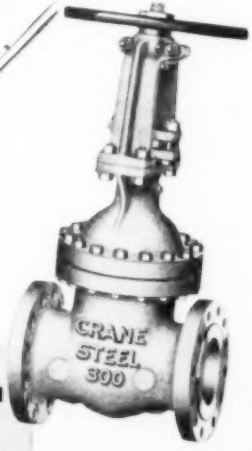
All the piping equipment shown on **This Vapor Recovery Unit,** for example, can be supplied by Crane—the **One Source of Supply** complete enough to simplify every piping procedure, from design to erection to maintenance. **One Responsibility** for materials helps to avoid delays on the job . . . results in better installations. **High Quality** in every item from Crane is your assurance of dependable performance all down the line—down every line.

CRANE Co., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



Process piping at tower structure in vapor recovery unit.

FOR PETROLEUM PROCESSING —*Crane recommends No. 33X 300-Pound Cast Steel Wedge Gate Valves. One of a complete line of steel valves trimmed to handle oil and oil vapor at temperatures up to 1000 deg. F. Crane steel gates, globes, angles, and checks are available in pressure classes from 150 to 1500 pounds. Flanged, screwed, or welding ends. See your new Crane Catalog, p. 223.*



EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

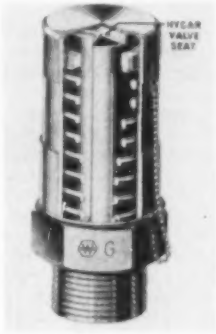
6—Drum Up-Ending Tool

Tool for upending barrels and drums is designed with a special clinching feature for positive safety, manufacturer states. The tool has no moving parts. It consists of V-shaped strap-iron saddles located at the point of lifting and at the point of leverage. The leverage saddle at the end of the tool laps over the top expanded rolling hoop, while the lifting saddle fits tightly to the drum head at two points under the rim, thus supporting the lifting weight. As leverage is applied, pressure forces the saddles to spread and grip the drum surfaces to prevent slipping or rolling. D. S. Campbell Co.

7—Grease Viscometer

The "Interchemical" Rotational Viscometer has been re-designed by Precision Scientific Co. with all operating parts in one housing. The cabinet's table top contains controls and dials within easy reach of the operator. Recommended for obtaining flow properties of greases and other similar products, the apparatus produces consistency curves in place of single point measurements, which may be misleading for plastic, thixotropic materials. It consists essentially of a rotating sample cup and a stationary bob immersed in it. The viscous drag on the bob is imposed on a coiled spring which is twisted through an angle measured on a calibrated disk. Cup rotation can be varied from 10 to 400 rpm. in 10 rpm. steps. Newtonian and plastic viscosities in the range of 1 to 2500 poises and yield values up to 180,000 dynes/sq. cm. may be determined. A constant temperature water bath provides control from 20 to 100° C., with a sensitivity of 0.1° C. Overall dimensions are 2 ft. 5 in. deep; 3 ft. 10 in. wide; 5 ft. 3 in. high. Precision Scientific Co.

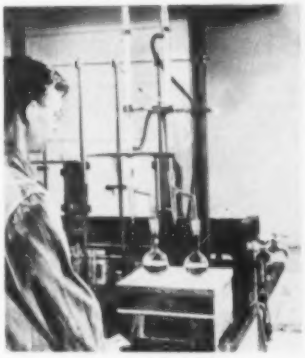
8—Propane Safety Valve



Propane can be handled with maximum safety in cylinders and tanks equipped with Weatherhead safety relief valves using an especially designed nitrile rubber valve seat made from Goodrich "Hycar." The material has been approved for use on ICC cylinders of up to 150 lbs. propane capacity, and for approved spring type safety relief valves on greater capacity ASME tanks. Advantage cited for the nitrile seat is that it will not stick to metal seats. Therefore pressure settings can be established which remain substantially constant over long periods of time. B. F. Goodrich Chemical Co.

9—Laboratory Hot Plate

Stepless heat control is said to be a feature of the "Temco" Hot Plate, which consumes current only 50% of the time after attaining a surface temperature of 500° F. Available in 12 x 12 and 12 x 24 in. sizes, the new device will maintain temperatures within close limits over the range 140 to 850° F. The elements are of the flat type, which prevent "cold" spots. The lower portion, housing controls, is separated from the cast aluminum top plate by insulation, and louvres help carry any heat away from the table top. The heater is furnished for either 115 or 230 volt operation. Fisher Scientific Co.



Building

- **FOR THE PETROLEUM INDUSTRY**
- We are fully staffed to design, build, and equip complete refineries and chemical processing plants.
- Under one contract and one responsibility, we deliver each job complete . . . ready for operation.
- We also furnish engineering reports and surveys. Current cost data available at all offices.

The H.K. Ferguson Co.
INDUSTRIAL ENGINEERS AND BUILDERS

THE FERGUSON BUILDING • CLEVELAND, OHIO
OFFICES IN NEW YORK, HOUSTON, CHICAGO, CINCINNATI AND LOS ANGELES

[To obtain more data on advertised products see page 80]

Here's the easy way to get all the answers quickly . . .

If you desire more complete information on any of the products, materials or services advertised in Petroleum Processing or described in its "What's New" section, we can help you get it quickly and easily.

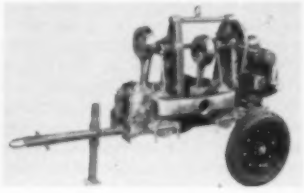
All the advertisements and "What's New" items appearing in this issue have been assigned key numbers. The advertisement key numbers appear in the Advertiser Index; each "What's New" item carries a code number in its headline.

To secure additional information about either an advertised product or a "What's New" item, merely circle its key number on the READER INFORMATION SERVICE card you will find in this issue. Then, fill in your name and other pertinent mailing data requested.

Mail the card today. No postage is required.

Petroleum Processing's Reader Service Department will follow-through promptly to get immediate action for you.

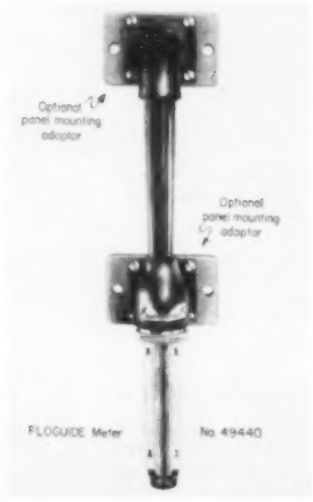
10—Construction Work Pump



Designed for muddy, or sand and debris-laden water, a new "Novo" double diaphragm pump has double the capacity of a previous single diaphragm model, because one diaphrahm is always pumping while the other is discharging. Gasoline engine-driven, the pump is mounted on a small, portable, rubber tired chassis for easy mobility. Novo Engine Co.

11—Gas Flow Meter

Easy readability is a feature of the "Floguide" variable-area gas flowmeter, whose wide-angle scale can be read from within a 180° arc. The tapered metering tube and "float" are of stainless steel. Tube is brazed to cast iron inlet and outlet fittings, permitting panel installations. The instrument is available in such capacities as: 45 to 16,000 standard cu. ft./hr., CO_2; 200 to 76,000 SCFH, H_2; 65 to 25,000 SCFH, natural gas; 45 to 16,000 SCFH, propane; 35 to 14,000 SCFH, butane; and other comparable rates. Although designed primarily for low pressures, it can be furnished to withstand 600 psig. working pressure in all sizes. Maximum operating temperatures limited by properties of commercially-available packings. Fischer & Porter Co.



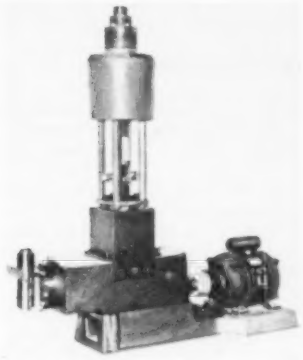
12—High Vacuum Gage

A new "McLeod" type high vacuum gage has been made available with a working range of 0.05 to 50 mm. Calibrated in mm., the lowest scale division is 0.01 mm. (10 microns). The wide range of the instrument is said to fill the gap between present low range vacuum gages and dial type measuring instruments. The gage weighs 6½ lbs., with overall dimensions of 7½ x 11⅞ x 4½ in. It is housed in a plastic case and furnished complete with one lb. of mercury. F. J. Stokes Machine Co.

13—Rust Inhibitor

A rust inhibitor for light oil products in static storage and pipe lines is being made available and will be sold under the trade-name "Santolene C." A hydrocarbon-soluble, water insoluble, non-metallic, organic material, it is intended for use in such products as gasoline, fuel oil, and kerosine. Treating cost at a dosage of 0.002%, or 0.75 gal./1000 bbls., with a displaced fuel credit of 10c/gal., is said to be about 0.14c/42 gal. bbl. The product is sufficiently effective at this dosage when tested according to modified ASTM D-665-47T against distilled water. Concentrations up to 0.01% may be necessary against sea water. Dosages up to 0.01% apparently have no effect on the usual specification items for gasoline, kerosine and No. 2 fuel oil, it is stated. An exception is the ASTM glass dish gum on gasoline at the higher concentrations, when a moderate increase may be noted. This increase is not more than 1 mg./100 cc. 0.002% Santolene C. Monsanto Chemical Co.

14—Proportioning Pump Control



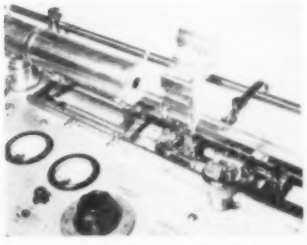
The "Auto-Pneu-Matic" control has been announced as an accessory to the line of "Pulsefeeder" proportioning pumps which will provide for pneumatic instrument control of the pump output. Output can be made responsive to any measurable variable—flow, pH, temperature change, liquid level, pressure, etc. Manufacturer states the accessory is suitable for use with all commercial pneumatic systems. Lapp Insulator Co., Inc.

15—Fatty Acid for Grease

"Lubrex 45", a new polyunsaturate-free fatty acid has been developed specifically for use in grease manufacturing. Stabilization of the fatty acids in the product by hydrogenation is said to give Lubrex 45 great resistance to heat discoloration. Freedom from polyunsaturated fatty acids prevents rancidity or gum formation. The melting point of the material is precisely controlled at 45° C. W. C. Hardesty Co., Inc.

16—Micro-Lab Furnace

Speed of analysis is greatly increased with a new micro and semi-micro, radiant type, combustion apparatus, and a separate 7-in. furnace for use in miscellaneous train assemblies. The apparatus is designed especially for use where a large volume of elementary analyses for carbon, hydrogen, and nitrogen in rare orgahic compounds is performed. It heats from room temperature to 700° C. in approximately seven minutes and cools from 750 C. to room temperature in about ten minutes. A two-speed automatic drive and programming controls provide four different three-phase programs, or two- or single-phase programs, as selected. In the complete apparatus, the long furnace measures seven in., and the moving furnace two in., with a travel length of seven in. at four or 12 mm./min. travel rates. A combustion tube up to 14 mm. OD can be accommodated. Maximum static time interval is 15 min.; maximum power consumption of complete unit is 600 watts. Operation is 115 volt, 60 cycle A.C. Complete unit is priced at $475; the individual furnace at $85. E. H. Sargent & Co.



17—High Strength Bronze Valve

A line of 150 lb. Hancock bronze valves with 500-brinell stainless steel seats and discs, and a diaphragm construction, are claimed to be 125 to 230% stronger than usual bronze valves of a similar type, according to the manufacturer. They are available in sizes of ⅛ through 2-in., in globe and angle types, screwed ends. Manning, Maxwell & Moore, Inc.

18—Smoke Density Indicator

The Photoswitch Excess Smoke Indicator, Type 2A10C, gives a continuous indication to the boiler room of the conditions of the flue gases, signalling when either smoke or air are sufficiently excessive to cause inefficient combustion or create a smoke nuisance. The instrument includes a photoelectric control and light source—mounted on opposite sides of the flue or breeching—and a Densometer located on the instrument panel board. Recording equipment is available for use with the indicator. The device operates on 115 volt A. C. Photoswitch, Inc.

Trade Literature

19—Liquid Phase Separation

Selas Continuous Liquid Separation, Bulletin 730: describes the use of a new membrane device for complete separation of phases with no moving parts; useful in production volume separation of emulsions, in solvent extraction, steam distillation, dewatering of solvents, etc. Selas Corp. of America.

20—Rapid Spectrophotometer

The Beckman Model "B" Spectrophotometer, Bulletin 210A: covers a new laboratory instrument designed for easy operation, rapid routine work, and at a low cost, in spectrophotometric analyses. National Technical Laboratories, Inc.

21—Kaskade Bubble Trays

Koch Kaskade Fractionating Tray, Bulletin 525: four-page folder presenting cost comparison figures and performance results on Kaskade trays as used in an absorption tower in a natural gasoline plant, in liquid-liquid extraction in a gasoline caustic wash tower, and in distillation in a train of five naphtha fractionators. Koch Engrg. Co., Inc.

22—Delayed Coking

The Kelloggram, Issue 5, Series of 1949, is devoted entirely to a discussion of progress in the design of delayed coking units, which are taking on increased importance in the face of the soft fuel oil market and which are significant as a preparation step to catalytic cracking. M. W. Kellogg Co.

23—Back Pressure Surge Study

Back Pressure Surge Effects on Safety-Relief Valves, a mimeographed "progress report" explaining the features of the Farris design for overcoming surge effects, which occasionally cause a valve to pop lower than its set point. Discharge piping for

ANOTHER REASON WHY

Badger

IS FIRST IN

expansion joints

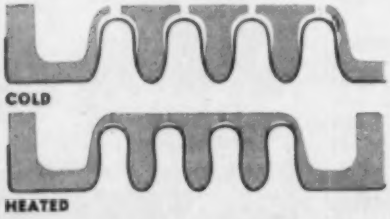
Because the flexing member is made from a single tube, Badger Expansion Joints may be installed without packings. In refineries and other petroleum processing plants this feature alone means valuable savings in man hours . . . assures long service without attention.

And that's only one reason why the petroleum industry depends on Badger Corrugated Expansion Joints for performance *at lowest cost*. Here are others:

- Fabricated from stainless steel or alloys . . . joints withstand the high temperatures and corrosion encountered in oil refineries and other petroleum processing plants.
- Controlled Heat Treating . . . assures corrosion-resisting qualities for long life.
- Flexible . . . joints easily compress and expand reducing thrust on adjacent fittings and equipment.
- Compact . . . require no more space than regular flanged fittings.
- Special forming methods . . . no danger of structure-weakening stresses.
- Directed flexing rings . . . to equalize stresses *between* and *within* corrugations.

These features are important in any pipe line job — you can get them *all* only by specifying Badger Expansion Joints.

Write today for Bulletin 100 (self-equalizing type) or Bulletin 200 (non-equalizing type).



EXCLUSIVE
all-curve corrugations equalize stresses

Although free to traverse axially, Badger Expansion Joints are constructed so that the Directed Flexing Equalizing Rings assure an even distribution of stresses whether caused by *temperature, pressure or movement* . . . there's no excessive strain at any point.

Badger MANUFACTURING COMPANY

260 BENT ST. CAMBRIDGE 41, MASS.

What's New!

collection systems can be reduced substantially in size with the properly designed relief valve, it is pointed out. Farris Engrg. Corp.

24—Water Treatment

Graver Two Stage Deaerating Heaters, a new bulletin outlining the principles of deaeration; describing design, operation, and applications of vertical and horizontal types of two stage deaerating heaters, including flow sheets of this type of apparatus in conjunction with other feedwater equipment in various pressure services. Graver Water Conditioning Co.

25—Petroleum Processing Index

PETROLEUM PROCESSING *Index* for 1949: includes subject and author index for all feature articles and regular departments for the 12 issues of this magazine published during 1949; available now. National Petroleum Publishing Co.

26—Pressure Vessel Accessories

Lenape Catalog 9-49; a 64-page booklet giving complete engineering data and specification details on pressure vessel accessories, including welding necks, manways, nozzles, covers, rings, studding outlets, saddles, fittings, and other press-formed specialties with dimensions, pressure ratings, codes, construction details, and service recommendations. Lenape Hydraulic Pressing and Forging Co.

27—Expansion Joints

Engineered Bellows Type Expansion Joints, Catalog 50; a 20-page handbook giving dimensional details on a line of expansion joints ranging from ½ to 72-in. nominal pipe size; includes table of thermal expansion of pipe in inches per 100 ft. Cook Electric Co., Magnilastic Div.

28—Precoat Filter Units

Oliver Precoat Filter, Bulletin No. 217; describes and discusses applications for continuous rotary vacuum filters of the precoat type, designed to clarify solutions difficult or impossible to filter by any other means, and where the cake usually is discarded. Oliver United Filters, Inc.

29—Vertical Centrifugal Pumps

Labour Type G Pumps, Bulletin 53; presents construction details, drawings, and general description of vertical, centrifugal, self-priming pumps which use no packing or mechanical seal; includes operating information and a table of friction of water in pipes. The Labour Co., Inc.

What's New!

30—Petroleum Test Equipment

TAG Oil Testing Instruments for Petroleum Products, Catalog No. 699H; 12 pages covering colorimeters, viscosimeters, thermometers, timers, cloud and pour test apparatus, flame and flash point testers, etc. C. J. Tagliabue Corp.

31—Quick-operating Valves

Everlasting Valves for General Services, Bulletin E-160; gives design and construction of quick-operating valves and their application to blow-off service, fire protection, water column blow-down, etc. Everlasting Valve Co.

32—Corrosives Handling

Durco Equipment for Chemical Process Industries, General Catalog M; condensed data on heaters, exchangers, steam jets, fittings, pumps, vessels, nozzles, condensers, tanks, tower sections, valves, in Duriron, Durimet, Durichlor, and Chlorimet alloys; arranged alphabetically for easy reference, with complete production range indicated, capacities and sizes, available alloys, and the like. The Duriron Co., Inc.

33—Feedwater Treatment

Cochrane Deaerators, Publication 3005; the latest revision of this 35-page bulletin catalogs deaerating equipment and covers the latest information on this method of treating boiler feedwater; including an article on the "Role of Alkalinity in Preventing Corrosion." Cochrane Corp.

34—Gas Analyzers

Gow-Mac "Ever-Tite" Thermal Conductivity Units, Bulletin OF-849; with diagrams, cutaway views; describes operation of electrical measurement of gas; includes specifications for new line of instruments. Gow-Mac Instrument Co.

For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 81. Just check the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

May we assist you, sir?

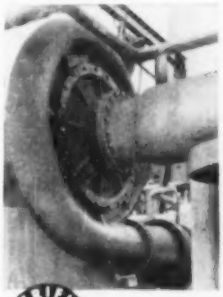
If you're on a merry-go-round about handling air or gas, *R-C dual-ability* can help you.

That's been our exclusive job for almost a century. We've developed the most extensive line of blowers, exhausters and gas pumps in the industry, with capacities from 5 cfm to 100,000 cfm.

We're the only builders offering that *dual choice* of both Centrifugal and Rotary Positive equipment. Thus, without bias, we can suggest units that meet most closely the requirements of the work to be done.

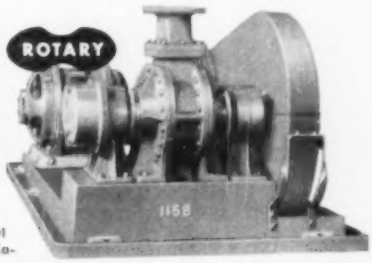
For new installations or replacements, look to us for your needs. Alert engineering teams up with modern construction to insure long-time, satisfactory performance of R-C equipment.

ROOTS-CONNERSVILLE BLOWER CORPORATION
501 Texas Avenue, Connersville, Indiana



Outdoor refinery installation of Type OI Centrifugal Blower. Capacity 11,750 cfm.

R-C Cycloidal Rotary Pump for handling gas or vapor together with liquids, in petroleum processing plant.



ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

[To obtain more data on advertised products see page 80]

EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Canada's New Fields Essential To Our Own National Security

PLACING an arbitrary limit on imports of crude oil from Canada, as has been proposed, would hamper our nation's efforts to assure the supplies of petroleum necessary to national defense, as well as handicap the economic development of the petroleum industry here.

The strategic value of the new oil supplies under the prairie land in Alberta and other Canadian provinces is so great as to make their discovery at this time almost an act of Providence on behalf of the two nations. It is only necessary to recall to mind the difficulties experienced in the last war resulting from submarine attack on tanker shipping along the East Coast, and even to some extent the West Coast, to appreciate the significance of the new large Canadian oil reserves. Their geographical location is important from a defense standpoint, and the oil taken from them is accessible by land transportation to many refineries in this country.

It is most important that the Canadian oil fields be developed as quickly as is possible in line with sound methods, to the point that their supplies of crude would be available in the event of a national emergency threatening the North American continent of free peoples. Pipeline facilities to move crude from the new Canadian fields are already under way, and such facilities to the west are contemplated. An estimated $100,000,000 was spent in 1949, much of it by American oil companies, in the oil fields of Alberta Province alone. The imposition of a restrictive limit on crude imported into this country from Canada would delay further development.

The peacetime progress of our own petroleum industry also will be best served over the years by the orderly development of the new Canadian oil fields. The fact the fields are a moderate distance outside our own boundary does not remove their natural geographic advantage as a source of supply to some refining areas in the U.S. The stimulus to agricultural and industrial development in Canada which will eventually result from the discovery of these large oil reserves likewise will benefit this country.

In the interests of both strategic security needs and the peacetime development, no limitations beyond those of natural economic competition should be imposed on the new oil fields in Canada.

Waste Disposal Is Public Relations

INDUSTRY in this country is spending between $200,000,000 and $300,000,000 annually for the elimination of air and water pollution caused by wastes from its plants, according to figures given out by the Industrial Hygiene Foundation of America. Yet criticism of firms for alleged failures in this regard is greater today than at any previous time. Such criticism stems partly from the fact that the growth in size and number of plants in some areas has created contamination problems where they did not exist when industrial activity was not such a factor in the community. It also comes from the alacrity of public officials to make industry the scapegoat for conditions for which it is not responsible, or where the negligence of public officials is at fault.

The most extreme instance of the latter cause is in Los Angeles, where its Board of Supervisors is trying to place the blame for the smog conditions there entirely on the petroleum refineries operating in the Los Angeles Basin, even going to the length of threatening to shut down the oil companies' plants in the event of another smog visitation.

The refineries in the Los Angeles area, through their Western Oil & Gas Assn., for years have carried on a program to eliminate all possible sources of noxious smoke and fumes from their plants, which to date has cost the companies participating over $10,000,000. The work of the oil and gas industry group is far ahead of what any other industry or any public authorities in Los Angeles have done to remedy the smog trouble. Reese H. Taylor, president of Union Oil Co. of California, and head of the Western Oil & Gas Assn., very properly has fought back at the charges which attempt to blame the petroleum refineries alone for the smog conditions. Among other arguments, he points out that the population in Los Angeles County has increased 47% in the past 16 years, with a proportional increase in the smoke and fumes thus caused, and the total number of industrial plants has increased 75%, while daily refinery throughput has grown only 35% in that period.

The situation in Los Angeles emphasizes the extent to which industrial waste disposal has become a matter of public relations in the community. Assuming voluntarily the leadership in the move to alleviate the air pollution that is a contributing factor in smog, the oil companies still find themselves confronted with the effort to make them the scapegoats in the issue.

Taking a lesson from the experience in Los Angeles, oil companies everywhere, along with their waste disposal programs, where a community air or water pollution problem does exist, should see to it that every effort is made to give the public an understanding of the nature of the pollution, the causes for it, and the steps the oil companies are taking to overcome it.

Adieu Ambrosia Elatoir!

THAT large fraternity whose members suffer from the malady of late summer and autumn which carries the inoffensive name hay fever may grasp a grain of comfort from a recent report of the New York State Department of Public Health. It concerns the use of sprays of petroleum and other oils to control weed growth along the highways.

In cooperation with the Department of Ornamental Horticulture of Cornell University, several oil and chemical companies have been experimenting with this means for keeping the roadsides free from heavy weed growth, but still covered with pleasing green vegetation.

The work is reported successful, at least to the degree it will be conducted on even a larger scale this coming summer. It is to be hoped that the scope of the new tests will include ragweed (A. elatoir), to whose pollen the nasal membranes are especially sensitive.

Sufferers from the seasonal affliction will await with baited, even though slightly asthmatic, breath for word of success that would provide a new role for the oil companies as benefactors of mankind.

CHEMICAL USERS' GUIDE

to General Chemical Products for the Petroleum Industry

ALKYLATION

ANHYDROUS HYDROFLUORIC ACID
Grades or Strengths: 99.0% HF min. (one grade only)
Packing: Steel Cylinders, Tank Cars

SULFURIC ACID
Grades or Strengths: Standard
66° Baume—93.19% H_2SO_4
99% H_2SO_4
Diamond—66° Baume
Crystal—66° Baume
Packing: Tank Barges, Steel Tank Cars, Steel Tank Trucks, Steel Drums, also Carboys

POLYMERIZATION or ALKYLATION

FLUOSULFONIC ACID—HO.SO.F (HSO.F)
Grades or Strengths: Min. Content 98% Fluosulfonic Acid
Packing: Steel Tank Cars, Steel Drums

BORON TRIFLUORIDE
Gas: Cylinders
Ether Complex: 47.88% min. BF_3; Packing: 5, 20 and 55 Gal. Drums
Phenyl Complex: Drums
For Bulk Quantities write Baker & Adamson Products, General Chemical Division, Allied Chemical & Dye Corporation, 40 Rector St., New York 6, N. Y.

SULFONATION

SULFURIC ACID

SULFAN "B" (Stabilized Sulfuric Anhydride)
Grades or Strengths: 99% SO_3 min.
Packing: 55 Gal. Drums

OLEUM
Grades or Strengths: 15% free SO_3 (103.38% H_2SO_4)
20% free SO_3 (104.5% H_2SO_4)
65% free SO_3 (114.38% H_2SO_4)
Packing: Steel Drums, Tank Cars, Tank Barges, Tank Trucks

ISOMERIZATION

MURIATIC ACID (Hydrochloric)
Grades or Strengths: Standard—18°, 20°, and 22° Baume
Packing: Rubber lined Tank Cars, Rubber lined Tank Trucks, also Carboys

DETERGENTS & BUILDERS

SODIUM METASILICATE
Grades or Strengths: Granular, thru 10 mesh; Powdered, 90% thru 40 mesh
Packing: Multiwall Paper Bags, Fibre Drums

DISODIUM PHOSPHATE
Grades or Strengths: Anhydrous
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM SULFATE, Anhydrous
Grades or Strengths: Standard, approximately 99.5% Na_2SO_4
Packing: Multiwall Paper Bags

TRISODIUM PHOSPHATE
Grades or Strengths: Coarse, thru 10 on 20 mesh; Medium, thru 20 mesh on 100 mesh; Standard, thru 20 mesh, 15-25% thru 100 mesh; Fines, thru 40 mesh, 50% thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

TETRASODIUM PYROPHOSPHATE
Grades or Strengths: Anhydrous, Powdered, 100% thru 20 mesh, 90% min. thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

ACIDIZING

MURIATIC ACID (Hydrochloric)
HYDROFLUORIC ACID

MUD CONDITIONING

SODIUM SILICATE
Grades or Strengths: Clear and Opalescent Grades in a wide range of viscosities ranging from 38° to 60° Baume
Packing: Steel Drums, Tank Cars, Tank Trucks

DISODIUM PHOSPHATE
TRISODIUM PHOSPHATE
TETRASODIUM PYROPHOSPHATE (TSPP)

OTHER CHEMICALS

Aluminum Sulfate, Standard & Iron Free
Aqua Ammonia
Sodium Fluoride
Nitric Acid
Potassium Nitrite
Other Heavy Chemicals

CATALYSTS and SPECIAL CHEMICALS

Companies requiring catalysts, addition agents, inhibitors, or other special chemicals "tailor-made" for their individual processes are invited to consult with General Chemical on their requirements. The same progressive research, technological "know how," and practical experience that has found the answer to so many petroleum chemical problems during General's long service to the Industry may help provide the solution to yours, too.

The products offered herein are commercial chemicals having various uses, some of which may be covered by patents, and the user must assume full responsibility for compliance therewith.

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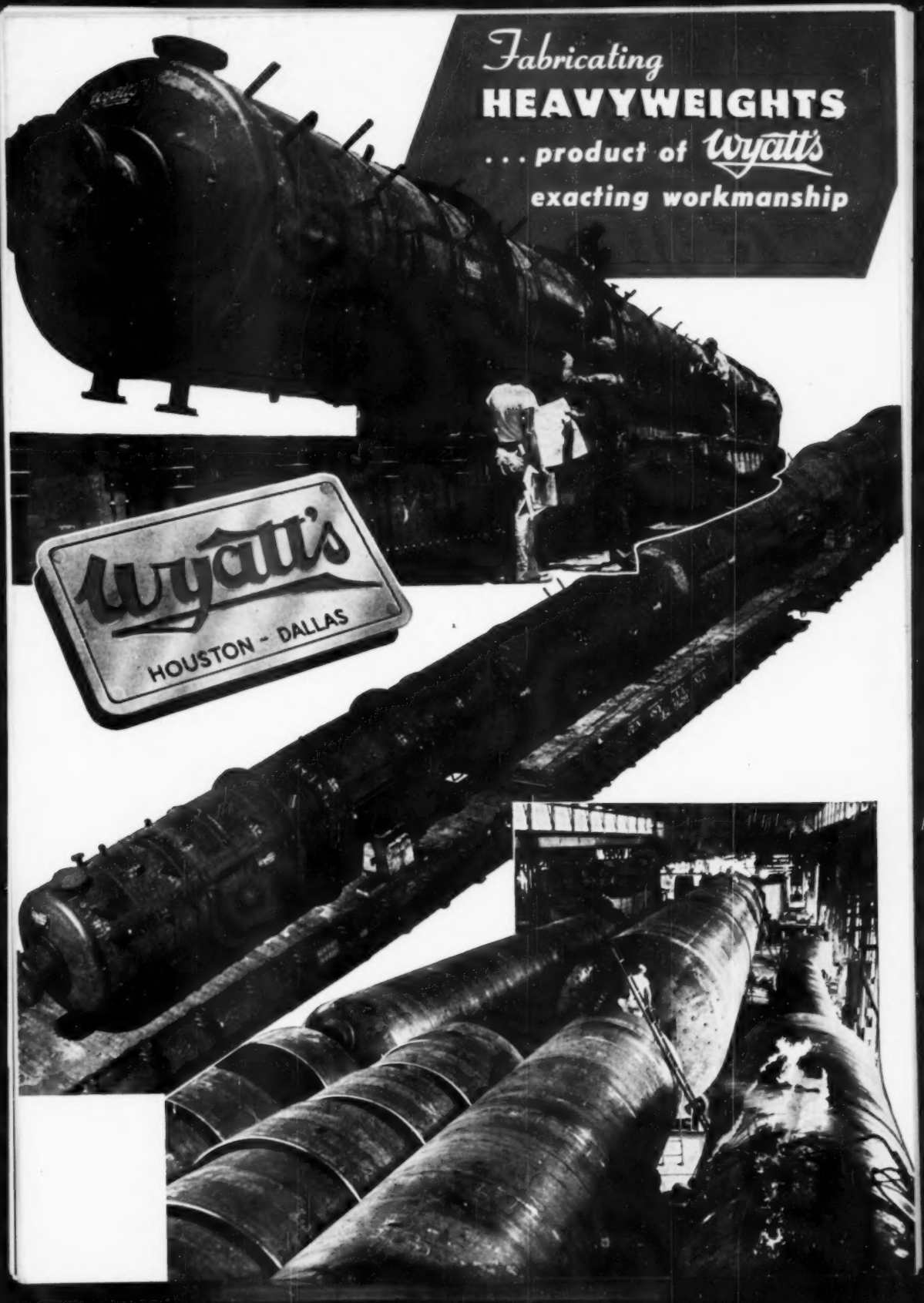
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